# Tappi

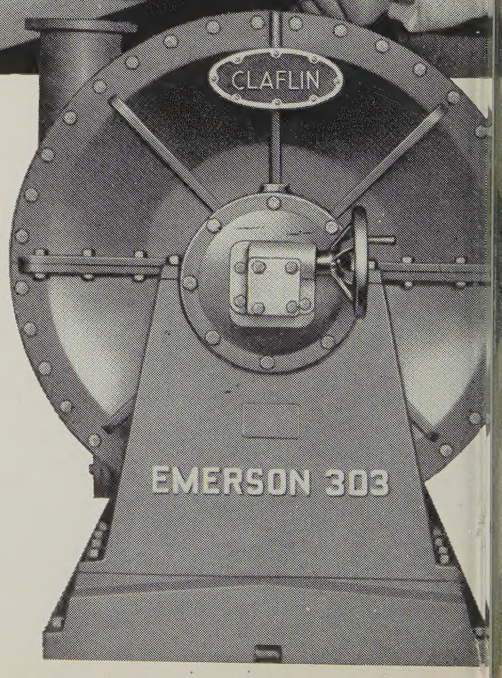
PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

MAY 1959

VOLUME 42 • NUMBER 5

# NEW.... Emerson CLAFLIN® 303

Research, engineering and industrial design have all contributed to the newly-designed EMERSON CLAFLIN 303 to achieve a combination of matchless operating efficiencies in a machine which is regularly meeting new demands of the papermaker from pulp mill defibering to paper mill refining. The 303 is built in Emerson's modern manufacturing facilities. It is backed by Emerson's reputation for quality. If you are considering refining equipment, learn *all* the facts about the new Emerson Claflin 303. Write The Emerson Manufacturing Co., Division of John W. Bolton & Sons, Inc., Lawrence, Massachusetts.




BOLTON EMERSON
TRADE MARK

*Courtesy: The Glidden Company, Chemicals-Pigments-Metals Division*

# Alpha® Protein...

## for true colors, depth and clarity

There are at least ten potential trouble spots in the photograph above. Yet everything reproduced here with full integrity—thanks to Alpha Protein, the acknowledged best-selling binder for high solids, machine-coated offset papers.

Alpha Protein is processed soy protein, carefully controlled through all manufacturing steps to insure *uniformity* from shipment to shipment.

Unlike imported adhesive materials which are subject to price fluctuation, Alpha Protein is stable in price.

Alpha Protein gives excellent results in either conversion or on-machine coating. It is perfectly compatible with coating pigments and allows the application of coatings containing up to 60 percent or more solids.

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**CENTRAL SOYA COMPANY, INC.**

**Chemurgy Division**

**1825 N. Laramie Avenue • Chicago 39, Illinois**

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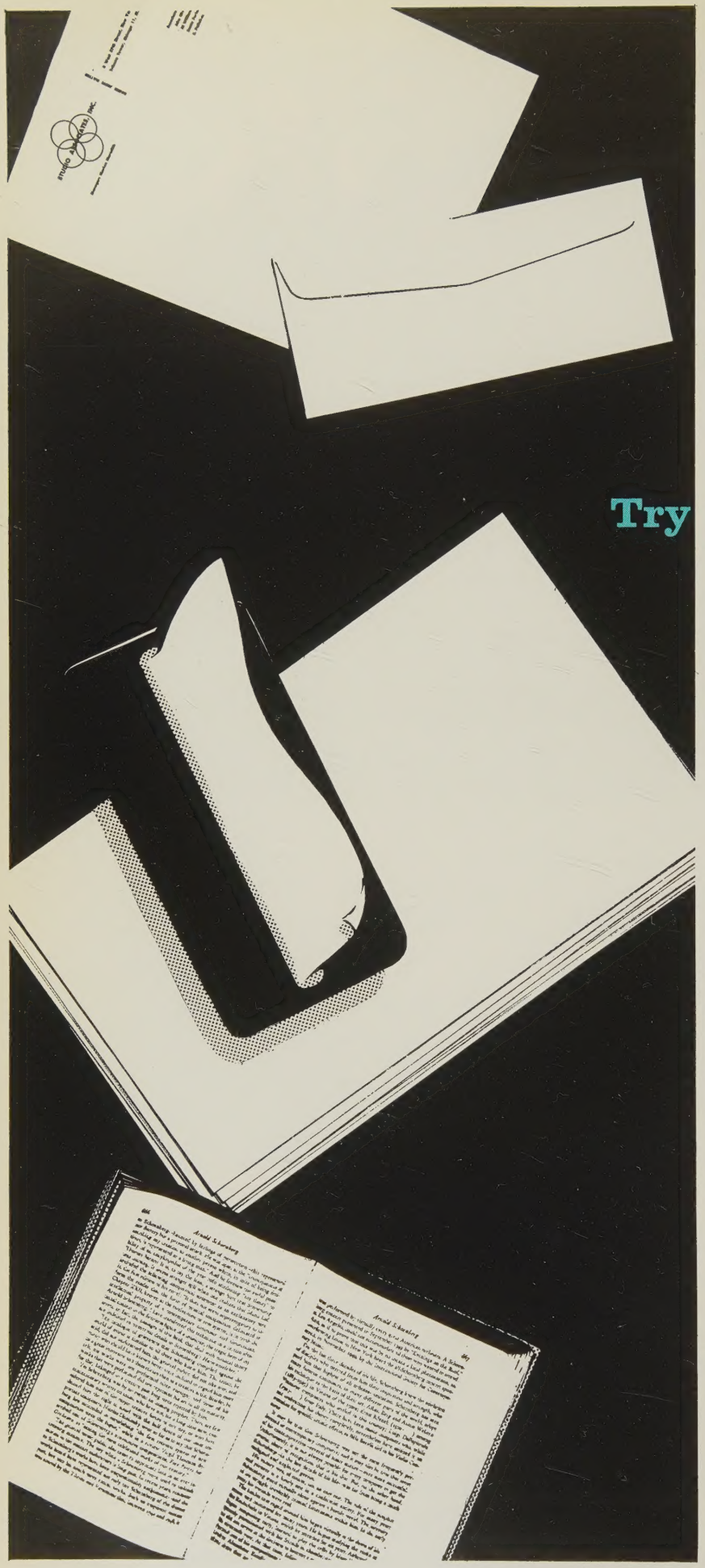


Geigy

this practical way of
producing uniform white tints:

Solophenyl® Blue 3RL
Solophenyl Blue 2RL
Diphenyl Bordeaux 6B

The above direct dyes can be used on continuous or batch coloring for producing a wide variety of white tints. These dyes have necessary fastness properties for adaptability on book, bond, tissue and bleached board specialties.

These dyes can be used in conjunction with

Tinopal® PW 300%
Tinopal 4BMA

for more brilliant and uniform whites.

Geigy's technical staff will be glad to assist you in the adoption of this suggestion.

## Geigy Dyestuffs

Division of Geigy Chemical Corporation
Saw Mill River Road, Ardsley, New York

Branch Offices: New England, Newton Upper Falls, Mass. • Appleton, Wisc. • Charlotte, N. C. • Chattanooga • Los Angeles • Philadelphia • Portland, Ore. • Chicago • Toronto • In Great Britain: The Geigy Co., Ltd., Manchester

MORE THAN **1079** PHYSICAL TESTING MACHINES

TESTING MACHINES INC.
tmi
A Catalog and Register of Testing Machines for all industries.
TESTING MACHINES INC.
MINEOLA, NEW YORK

Most of them are in the NEW 224 Page TMI

# Catalog and Register of Testing Machines

## NOT ONLY PAPER!

. . . as most everyone knows, TMI **DOES** have the largest grouping of Pulp and Paper Testing Equipment available from one source—all described in the new catalog . . .

## BUT — there is much more . . . FOR EXAMPLE:

- 87 Broad categories of testers—Frequently with 20 or 30 specific machines in one category.
- A complete listing of our Plastic Testers for those interested in combinations and laminates of Paper Products and Plastics.
- Calibrating and maintenance devices.
- Components for your own design and experimental purposes.
- Testers of interest to the plant manufacturing sections, such as Rockwell Hardness Testers and Durometers for checking metal and rubber rolls and other parts.
- Thermometers, Gauges, Gauge Testers, Pyrometers and other control devices.

**No Technical or Purchasing Department should be without this Valuable Reference Manual. . . . More than a year in preparation and filled with up to date, interesting, information.**

**May we present a complimentary copy to you?**

**TESTING MACHINES INC.**
**72 Jericho Turnpike, Mineola, L. I., N. Y.**

**TESTING MACHINES INC.**
72 Jericho Turnpike, Mineola, L. I., New York

☐ YES, indeed, I would like a Free Copy of the New Catalog and Register of Testing Machines.

Name_____

Position_____

Company_____

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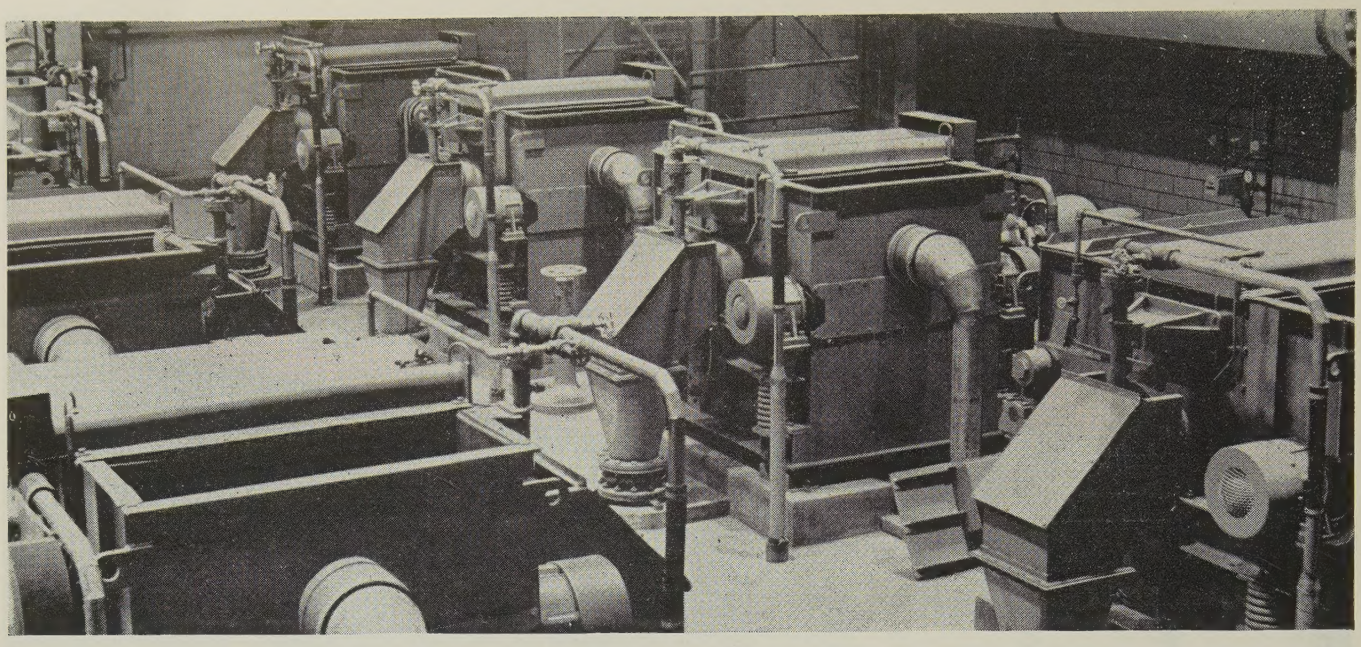


# *For High Quality, Slotted Plate Screening At High Consistency, At Low Cost*

# — the BIRD VIBROTOR SCREEN

## *This is the Screen:*

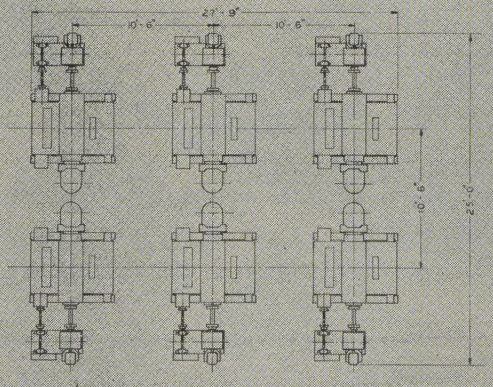
— that handles stocks up to 2% or higher consistency.

— that handles up to 60 t.p.d. of 1.7% unbleached kraft or bleached sulphate through .012″ slots.

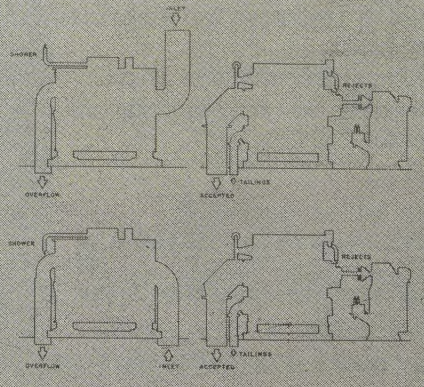
— that handles up to 80 tons of coarse kraft or 90 tons of mixed pine and short filtered stock with .012″ slots.

— that handles up to 150 t.p.d. of 2% deink through .012″ slots.

**BIRD MACHINE COMPANY**
**SOUTH WALPOLE, MASSACHUSETTS**
REGIONAL OFFICES: EVANSTON, ILLINOIS • PORTLAND, OREGON • ATLANTA, GEORGIA
Canadian Manufacturers of Bird Machinery, CANADIAN INGERSOLL-RAND CO., Limited, Montreal




*Vibrotor Screens Save Space* — look how compact a layout you can make — six screens in a space 25 ft. by 27 ft. 9 in. The drives may be located on either side.




*Vibrotor Screens are flexible — save auxiliary equipment expense* — stock inlet may be above or below the screen — discharge at the side or below. High density screening means less thickening, less pumping, less piping.

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The Technical Articles are in accord with the recommendations of the Division of Pulp, Paper, and Board of the International Union of Pure and Applied Chemistry.

PHOTO BY EWING GALLOWAY, N. Y.

HAM FELTZ says:

# "Reminds me how HAMILTON Felts run water"

YOU CAN'T BEAT

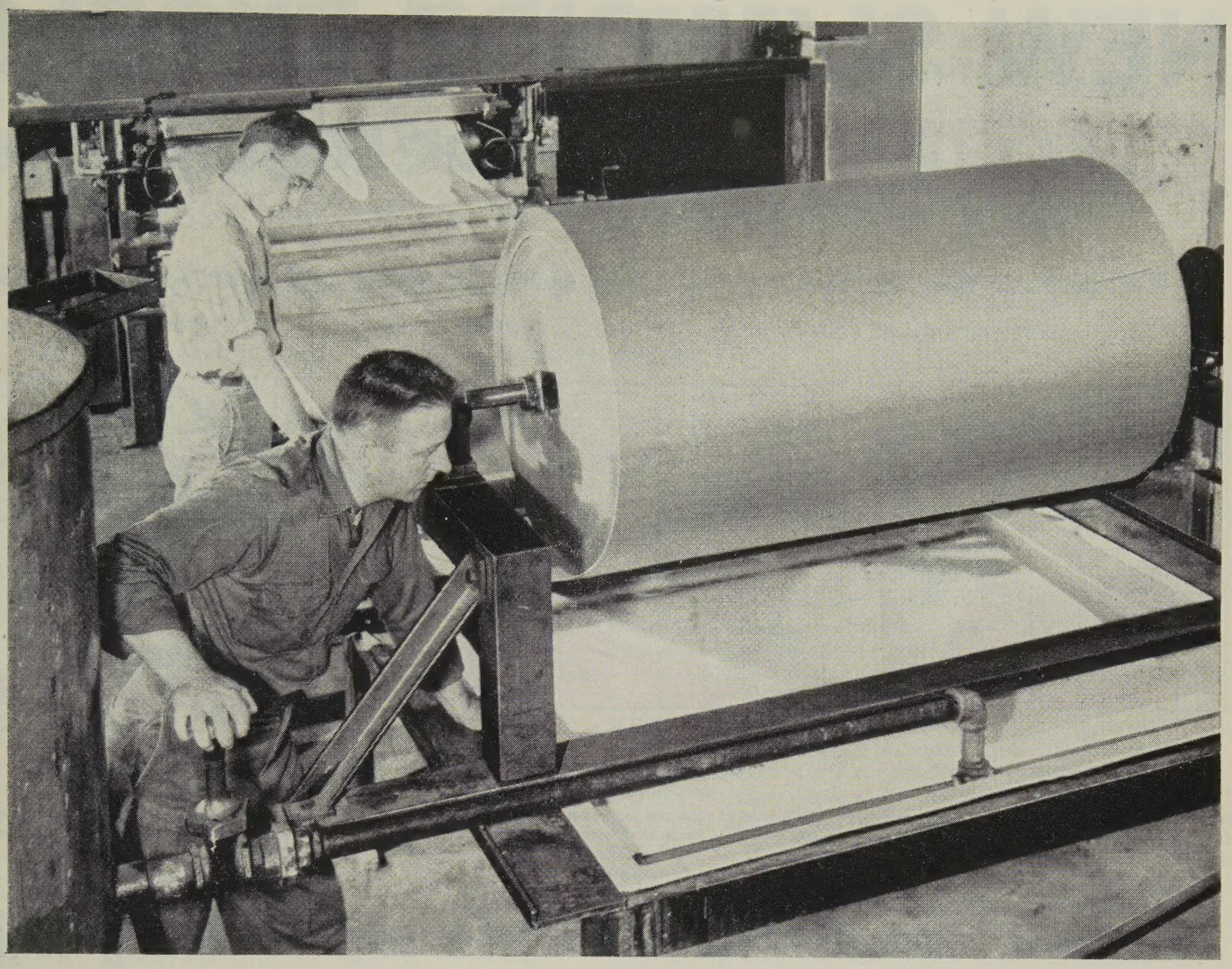
**Hamilton**

**FELTS**

Hamilton Felts run water like a sieve. They're "water-conditioned" for fast water removal so they deliver drier sheets to the drier, permit operators to run machines at higher speeds with fewer stops, less broke.

If this is the performance you'd like felts to give contact us—today!

**SHULER & BENNINGHOFEN, HAMILTON, OHIO**



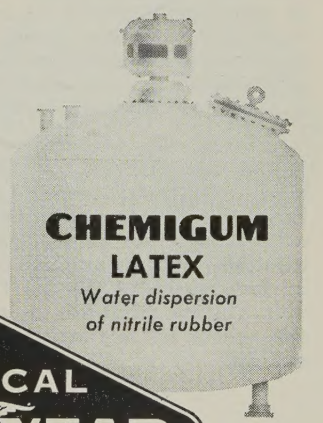
# What's the Score on Off-Machine Saturation?

More and more manufacturers are turning to off-machine saturation as a low-cost means of improving various papers. And many of them are finding CHEMIGUM LATEX the ideal saturant.

Pictured above is a case in point. The product involved is sheet gasketing. By saturating the cork paper base with CHEMIGUM LATEX, its manufacturer put an end to shrinkage in storage or in service against water. He also greatly improved its strength, resilience, compressibility and resistance to heat, gasoline and oil. Moreover, he made these improvements with surprising ease and economy.

Off-machine saturation of sheet gasketing takes advantage of just some of the property improvements that can be imparted to a variety of stocks by the addition of CHEMIGUM LATEX. Others include: Better feel and drape, higher internal and edge tear, and added burst strength. Typical applications include: Shoe insoles and midsoles, tapes and coated artificial leather.

If you are interested in improving your situation on off-machine saturation, why not get the full story on CHEMIGUM LATEX. Just write for details, including the latest *Tech Book Bulletins,* to Goodyear, Chemical Division, Akron 16, Ohio.




CHEMICAL
GOODYEAR
DIVISION

COATINGS
DEPARTMENT

Chemigum, Plioflex, Pliolite, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIOVIC • WING-CHEMICALS

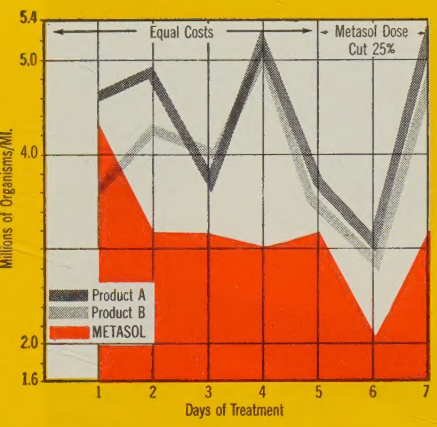
High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries

# NEW SLIMICIDE EXCELS

## METASOL® chosen for regular use

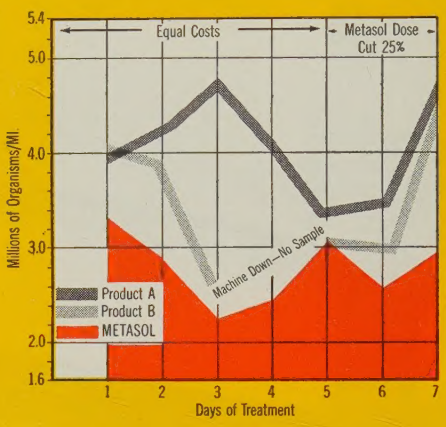
### What happened when METASOL was mill-tested against two widely used conventional slimicides

*Run parallel at equal prices with results verified by impartial mill engineers*



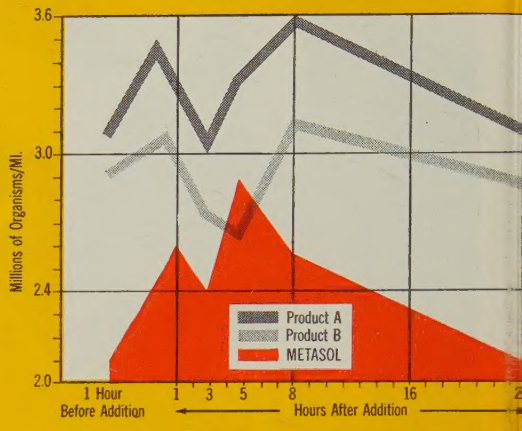

**25% to 35% MORE EFFECTIVE QUICK KILL**

Daily count of organisms per milliliter over a seven day period, **one hour** after addition of slimicide.




**30% to 40% MORE EFFECTIVE SUSTAINED KILL**

Daily count of organisms per milliliter over a seven day period, **23 hours** after addition of slimicide




**25% to 30% MORE EFFECTIVE AVERAGE KILL**

Daily count per milliliter on hourly basis, from one hour before addition of slimicide to 23 hours after.

## The same conclusive result from tests at three leading mills

### METASOL compared with conventional slimicide

In this bleached-kraft, hardwood pulp mill, solid METASOL replaced a solid conventional slimicide on an equal cost basis. Schedule for both slimicides was three times a day, at eight-hour intervals. All exposed parts, both wood and stainless steel, had been slime-coated when previous slimicide had been used. METASOL cleaned them after the first run.

Compared with a second machine, in which no slimicide was used, the METASOL-treated machine showed an organism count only half as high, even though the no-slimicide machine was washed down 7 to 15 times as frequently as the METASOL unit. The low count was maintained throughout six months of continuous use.

### METASOL in ground wood

METASOL was tested against two conventional slimicides in a newsprint mill using a mixture of ground wood and sulphite pulp. All three were run parallel at equal prices.

After only a few days, METASOL showed a far superior level of protection. At the request of mill management, the METASOL dose was dropped 25% in cost below the other two slimicides. METASOL continued to show a superior rate of protection and, over a two-week period, built up still more protection, then leveled off evenly. Over a three-week period, the machine using METASOL had higher productivity, no sign of microbiological slime break, and a much lower organism level.

### METASOL in comparative performance test

In a test at a bleached-kraft mill, one machine was treated with solid METASOL and the other with a solid conventional slimicide on an equal cost basis. At the start of the test, both machines showed a count of 4,000 organisms per milliliter. After 24 hours, the machine using the conventional slimicide showed a slime build up. Consequently, the METASOL treatment was reduced one-third.

At the end of a week, the count on the machine using METASOL had been cut to 2,000 per milliliter, while the count on the other machine had built up to 12,000 organisms per milliliter. In addition, the machine treated with METASOL had produced 17% more paper.

# METASOL®
# SLIMICIDES

# IN MILL TESTS
# after successful trials

**MILLS GIVE METASOL® HIGHEST RATING!**

- Most complete slimicidal action
- Most economical
- Highest, fastest solubility in water
- Odorless
- Colorless
- Harmless to equipment
- Minimum deactivation
- Sustained effectiveness
- Thoroughly field-proved

## *Scores on dollar-efficiency basis*
## *Gives around-the-clock protection*

METASOL is a completely new type of slimicide. It has been developed after seven years of research, during which it was evaluated against almost 2,000 other compounds, including all conventional formulations.

Thoroughly tested by leading mills, METASOL has been found superior to any other slimicide on the market. Every mill which has tried it has decided to use it on a continuing basis.

### Keeps machines running

METASOL lowers production costs because it keeps machines clean and helps them deliver a finer product without loss of time. One mill which previously had to shut down weekends for wash-downs now runs five continuous weeks without a shut down. Daily production has gone up also.

### Protects against all organisms

Of all commercial products tested, this new slimicide provides the most effective "quick kill" and "sustained kill" action against bacteria, fungi and other micro-organisms. It is so effective that doses can be reduced substantially compared with conventional slimicides, and still produce better results. Furthermore, tests show that, unlike other slimicides, METASOL does *not* permit microorganisms to develop resistance.

### Lowest cost

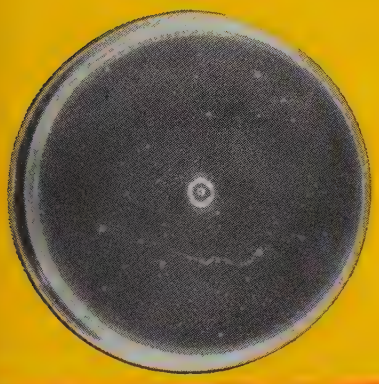
METASOL is the most economical slimicide you can buy. It costs far less per-effective-dose. It has the highest and fastest solubility in water. You can use it in dry (METASOL-P) or liquid (METASOL-L) form, whichever your particular mill situation may require.

### Demonstration in your mill

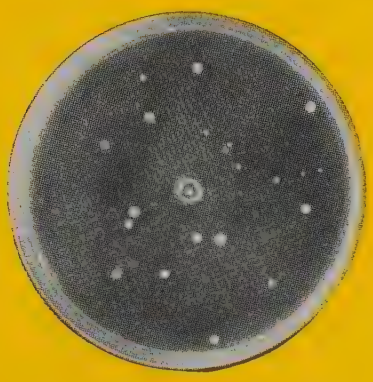
METASOL chemists and micro-biologists will demonstrate its effectiveness in your mill, on your machines, under normal production conditions. On request, they will analyze your particular slime problem, recommend corrective and preventive measures, and train members of your own organization in efficient slime-control methods.

Use the coupon on the bottom of this page to ask for your copy of a new brochure which shows exactly how METASOL slimicide works, and actual comparative performance records under mill-run conditions.

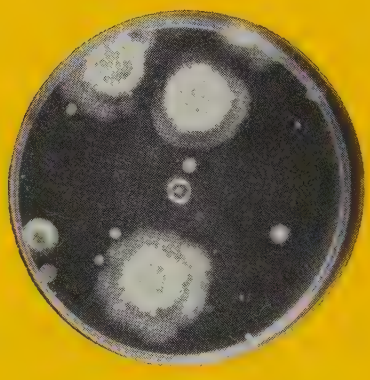
## 21 DAY TEST SHOWS SUSTAINED KILL



**METASOL®**



**PRODUCT "A"**



**PRODUCT "B"**

**METASOL DIVISION**
**Metalsalts Corporation**

200 Wagaraw Road
Hawthorne, New Jersey

In Canada:
Guardian Chemical & Equipment Co., Ltd.

Send new METASOL slimicide brochure detailing cost and production savings established by actual mill records.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____ CITY_____ ZONE____ STATE_____

# NEW *never before available*

# SUMSTAR™

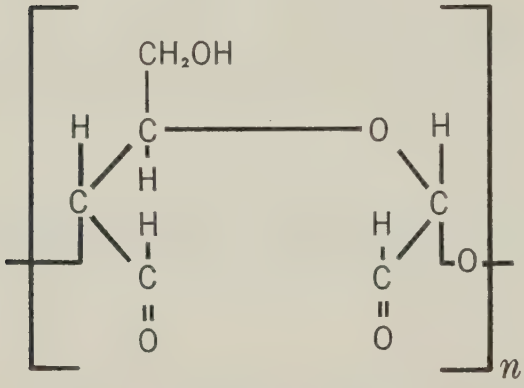
## a polymeric dialdehyde

For the first time, a new polymeric dialdehyde, Dialdehyde Starch, is offered under the name SUMSTAR™ by Sumner Chemical Company.

Originally developed by the United States Department of Agriculture's Northern Utilization Research & Development Division, the process has been adapted for manufacture by Sumner.

Dialdehyde Starch is described as "cornstarch oxidized by periodate ion. Oxidation breaks the carbon-to-carbon bond between $C_2$ and $C_3$ of the starch molecule's glucose units, forming a dialdehyde unit. Any number of glucose units can be oxidized, depending on the properties wanted at the time." (Chem. & Eng. News, Dec. 9, 1957)

Following is the structural formula and the list of tentative specifications for SUMSTAR now being made in limited quantities. (The specifications will vary, of course, for specific grades and types of SUMSTAR.)




**description:** Free-flowing white to pale yellow powder

**percent aldehyde content:** As required (corrected for water)

**currently available:** 1. Over 90%
2. 75%-80%
3. 50%

**water:** Less than 10%

**heavy metals:** 20 ppm. maximum

**sulfated ash:** 1% maximum

The applications of this polymeric dialdehyde for industry appear to be almost unlimited. Many uses have already been evaluated and many others are in the process of evaluation. Here are some of the principal industrial applications which are being evaluated:

**leather**—tanning
**textiles**—crease resistance and waterproofing
**plastics**—new polymers
**paper**—increase in wet strength

The many areas in which applications research on SUMSTAR is under way cover as broad a range as the chemical industry itself. Here is, for example, a polymer with the functional groups of glyoxal. Evaluation of SUMSTAR as a photographic hardener, bacterial inhibitor in cutting oils, vulcanization retardant, coating for printing plates, etc., are a few suggested areas for product development and process modification with SUMSTAR.

SUMSTAR™ is now available in limited quantities. Samples are available upon request.

**SUMNER CHEMICAL COMPANY**
***Division of Miles Laboratories, Inc.***

Zeeland, Michigan • General Sales Offices: 6 E. 45th Street, New York 17, N. Y. • MUrray Hill 2-7970
*West Coast:* B. W. Holmes, La Canada, California • Address inquiries to New York Office.

# The DRYER FELT they are all talking about—

# The SCAPA Synthetic Reinforced Cotton Dryer Felt

has been granted
U. S. Patent No. 2,882,933

Types 1166-S, 1164-S, 1464-S
2070-S and 2064-S are
Drying **more** paper **better**
every day

**SCAPA** known throughout the world wherever paper is made

**Morey Paper Mill Supply Company**
309 SOUTH STREET, FITCHBURG, MASSACHUSETTS

Sole U. S. Agents for

**SCAPA DRYERS, INC.**
WAYCROSS, GEORGIA

General Mills, Inc.

PRODUCTS CONTROL

• • •

QUALITY AND UNIFORMITY *INSURED*

N W E S

*wherever paper is made...* **GUARTEC** *is making it better!*

**GENERAL MILLS'** pure guar gum *strengthens, improves* surface of many grades of paper.

**1** ***kraft liner board*** — here GUARTEC improves mullen. Frequently faster machine speeds and less refining are extra advantages.

**2** ***cylinder liner board*** — again, better mullen *plus* opportunity to use lower-cost grades of waste paper in the furnish!

**3** ***corrugating medium*** – GUARTEC gives increased stiffness, and is particularly successful in waste paper furnish grades.

**4** ***book paper*** — including ground wood printing, rotogravure, and magazine paper — GUARTEC improves surface, formation, fuzz-lay-down, printability and clay retention.

**5** ***fine paper*** — as in book paper, GUARTEC shows a marked improvement in surface and formation characteristics, and can provide economical *clay retention.*

**6** ***multi-wall bag paper*** – GUARTEC can offer higher tensile strength with no real loss of tear strength! It also improves porosity of multi-wall bag paper.

**NOTE:** Guartec carries the General Mills Products Control Seal which means that a composite sample of every lot is fully checked for dispersibility and quality standards.

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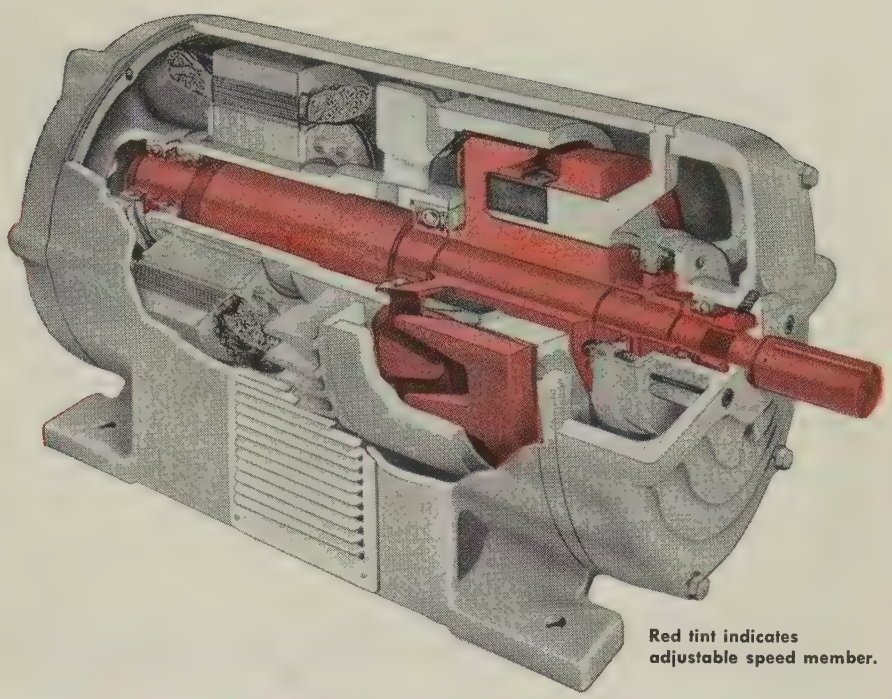

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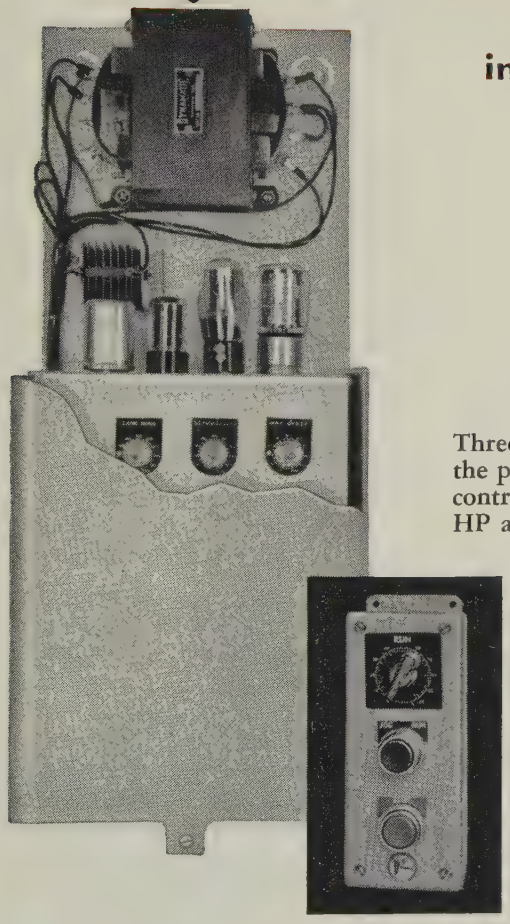

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# Utilization of Spent Sulphite Liquor Carbohydrates

A. J. WILEY, L. M. WHITMORE, JR., and L. A. BOGGS

THE carbohydrates in the spent liquor from the acid sulphite pulping process have been problem children during the entire 80 years that sulphite pulp has been produced commercially. It is these wood sugars and their degradation products which chiefly account for the biochemical oxygen demand of this pulp mill effluent when discharged to rivers and other dilution waters. The stream pollution problem has, in turn, been of much concern as a principal factor in holding back the further development and expansion of the acid sulphite process. The competitive status of the sulphite industry is seriously threatened by the prospect of forced installation of costly and loss-producing pollution control processes.

Investigation of processes for economic disposal, or more important, for profitable utilization of these wood sugars has been the subject of an enormous and long-continued effort in pulping research centers the world over. Although a number of utilization processes are available, the sulphite industry does not yet have in sight sufficient markets to absorb the available sugars on an industry-wide scale at prices which could support the high costs of recovery.

The quantity of wood sugars contained in the annual production of spent sulphite liquor exceeds 1 million tons on a world-wide basis, and more than a half million tons are produced each year by the 67 sulphite mills in the United States. Although this quantity is only a fraction of the potential which could derive from the wood industries, it nevertheless represents a substantial tonnage which has the definite advantage of being collected at and available to central processing plants. This availability in quantity is a first step along the road to economic utilization. The average-sized sulphite pulp mill has some 15 to 30 tons of sugar available from its daily production, and there are a number of larger units producing 100 or more tons of sugar daily.

However, waste carbohydrates are in the dime-a-dozen category in these years of continued agricultural surpluses. Research organizations charged with the task of finding uses for the carbohydrates of spent sulphite liquor are necessarily left with the burden of proving that these wood sugars and their derivatives have unique properties of greater value and lower cost than those which can be obtained from other carbohydrates. Even more important, it must be demonstrated that the actual or potential markets for these sugar products are adequate to justify large capital expenditures which all too often tend to be in the million-dollar class for a minimum-sized, break-even production facility.

A large and growing literature is replete with ideas advanced for solution of these difficult problems and it is not surprising that most ideas fail to meet the requirements of a successful process. In recent years, the sulphite pulping industry has underwritten organized research by central research teams to supplement the work of many individuals in a further attempt to find adequate methods for utilizing spent sulphite liquor. This paper reviews a number of developments showing significant progress, and also a few of the potentials for further advancement in the utilization of the carbohydrates from this spent liquor.

A. J. WILEY, Technical Director, L. M. WHITMORE, JR., Assistant Director, and L. A. BOGGS, Carbohydrate Chemist, Sulphite Pulp Manufacturers' Research League, Appleton, Wis.

## NATURE OF THE CARBOHYDRATES

The hydrolytic reactions which occur during the pulping of wood by the acid sulphite process cause the polysaccharides originally present in the wood substance to break down to various degrees. The final spent liquor is derived from controlled rates and degrees of pulping which produce different grades and types of cellulose fiber from one or more of the numerous kinds of wood utilized. These spent liquors can, therefore, be expected to contain a variety of carbohydrates, including typical wood-derived hexose and pentose sugars, degradation products of these sugars, and small amounts of soluble oligosaccharides. Free wood sugars in solution are the predominant carbohydrates in most spent sulphite liquors, and usually range from about 15 to 20% of the total dissolved solids.

Table I provides analytical information on the composition of the dissolved solids of representative spent sulphite liquors produced from softwoods and hardwoods. In considering utilization of the carbohydrates, it is of particular interest to note the differences in the relative content of hexose and pentose sugar in the liquor from these two types of wood. Most of the sugars in softwood liquor are hexoses, while in hardwood liquor the pentoses are predominant. This relationship has an important effect upon the products which can be produced from the pulping of the two different types of wood. Table I also shows an appreciable content of sugar degradation products about which much yet remains to be learned. The sulphite pulping process involves hydrolysis of the hemicelluloses of the wood to free sugars; as with other methods of wood hydrolysis, it is well known that complete hydrolysis results first in the production of free sugars, and then in concurrent degradation reactions which break down the free sugars to sugar acids and other products. The de-

**Table I. Components of Spent Sulphite Liquor**
(A comparative approximation)

| | *Softwood, %* | *Hardwood, %* |
|---|---|---|
| Lignosulphonates | 55 | 55 |
| Hexose sugars | 14 | 4 |
| Pentose sugars | 6 | 16 |
| Sugar acids and residues | 12 | 12 |
| Resins and extractives | 3 | 3 |
| Ash | 10 | 10 |
| | 100 | 100 |

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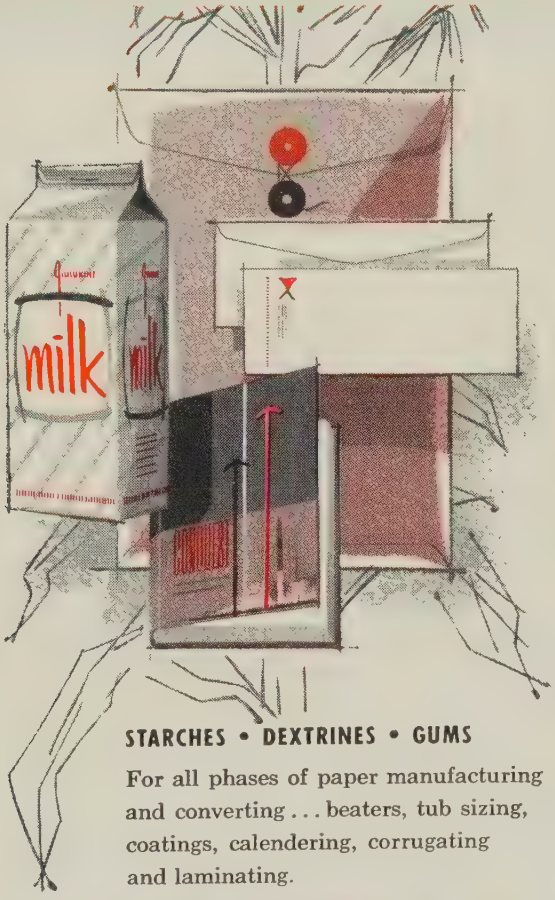


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gree to which these degradation reactions take place may be affected materially by the type of pulping process and the degree of cooking employed in the pulp mill. It seems probable that from 10% to more than 50% of the wood sugars derived from the hemicelluloses in the complete process may be degraded in this way.

It is true that most pulp mills would prefer to consider the yields and quality of cellulose fiber as primary factors in their over-all pulping operations, even though the methods used in pulping may materially affect the economics of using the carbohydrates of spent sulphite liquor. However, most pulp mills which have attempted to carry out a utilization program have found it worth while to consider economical adjustments in their pulping methods to give the best qualities possible in the spent sulphite liquor sent to recovery systems.

The individual sugar components, typical of the spent liquors produced from softwood and hardwood liquors, are shown in Table II. Mannose is the predominant hexose sugar in liquors derived from softwoods, while xylose is the predominant pentose sugar from the hardwood spent liquors. Glucose is found in minor quantities in both types of spent liquor. This sugar may have additive values in the over-all recovery scheme, but cannot alone be expected to have sufficient value to merit isolation. Galactose, available particularly from softwoods, and arabinose, available in smaller quantities, are the two remaining wood sugars found in spent sulphite liquor. If we are to find new markets for the wood sugars, it seems apparent that we should look particularly for properties which may be unique and marketable in mannose and xylose or in their derivatives, and consider the galactose and arabinose products to a lesser extent.

**Table II. Wood Sugars of Spent Sulphite Liquor**
(A comparative approximation)

| | *Softwood, %* | *Hardwood, %* |
|---|---|---|
| Hexoses | | |
| Mannose | 8.0 | 2.0 |
| Galactose | 4.0 | 0.5 |
| Glucose | 2.0 | 1.5 |
| | 14.0 | 4.0 |
| Pentoses | | |
| Xylose | 5.0 | 15.5 |
| Arabinose | 1.0 | 0.5 |
| | 6.0 | 16.0 |

## FERMENTATION

Utilization of the carbohydrates of spent sulphite liquor has traditionally been centered on fermentation methods. One advantage of fermentation is that the sugars are converted to products which are more easily recovered from the dilute solution. Some of the products which can be produced from sulphite liquor by fermentation are lactic acid, fumaric acid, acetone, butanol, butyric acid, propionic acid, acetic acid, and methane. However, the only commercial products are ethyl alcohol and yeast. In the ethyl alcohol fermentation by *Saccharomyces* yeast, only the hexoses are utilized, so that a hardwood liquor in which pentoses predominate would not be suitable. On the other hand,

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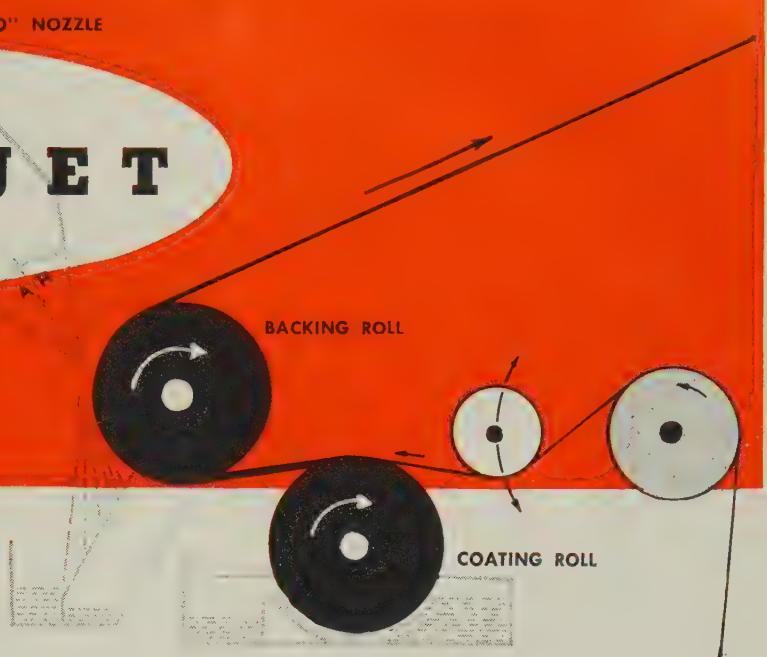


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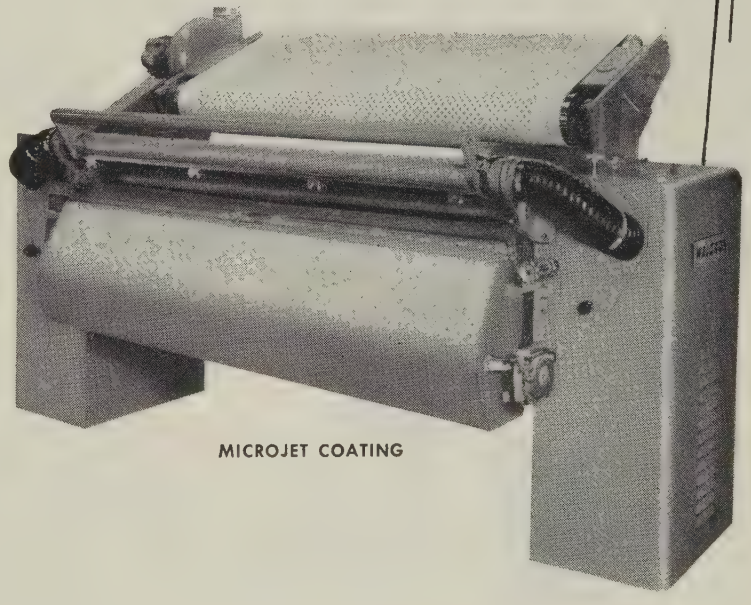

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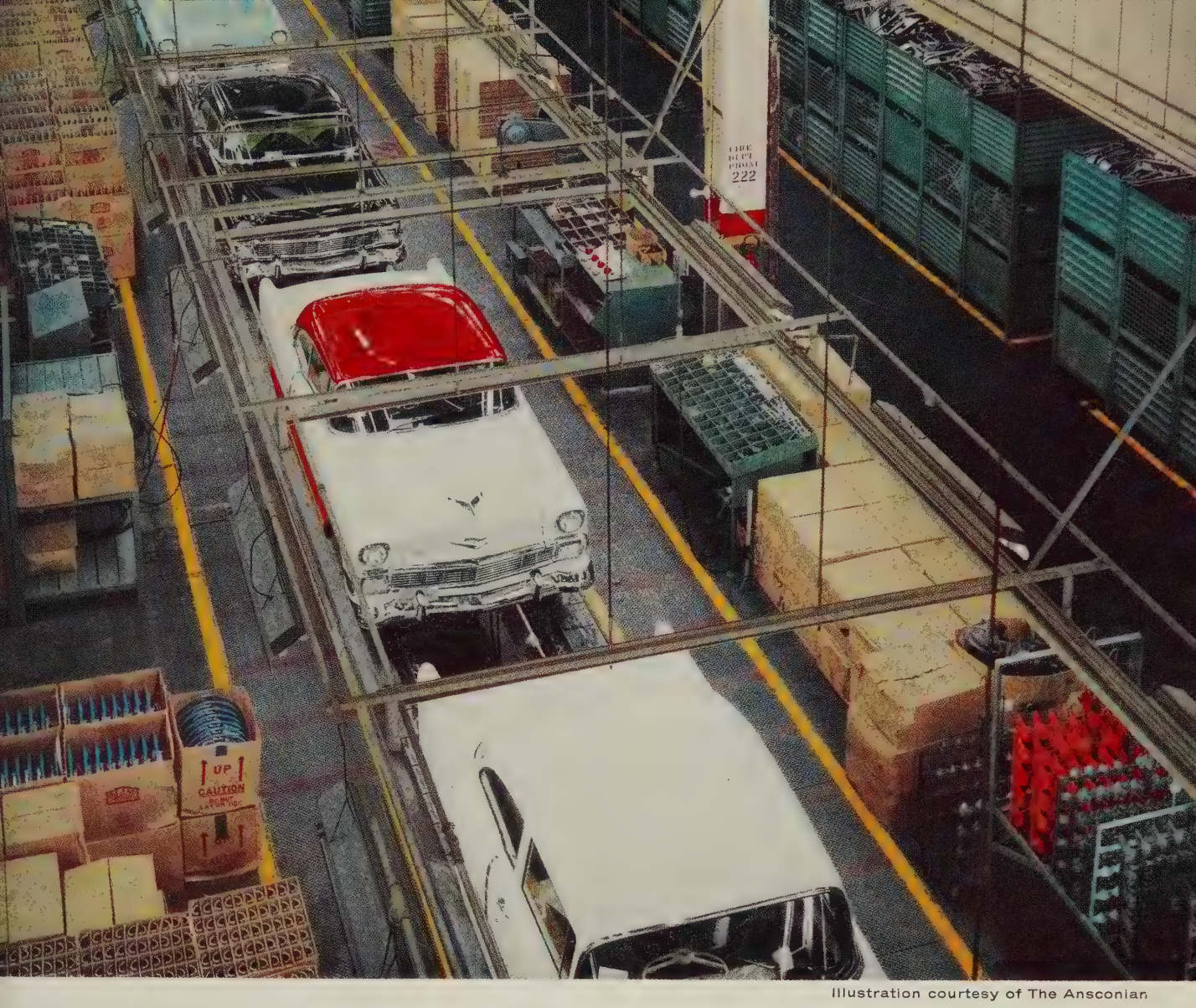


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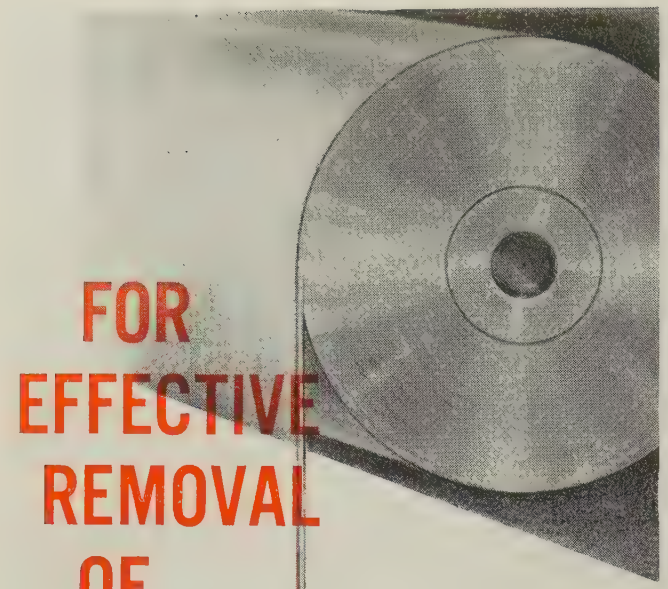

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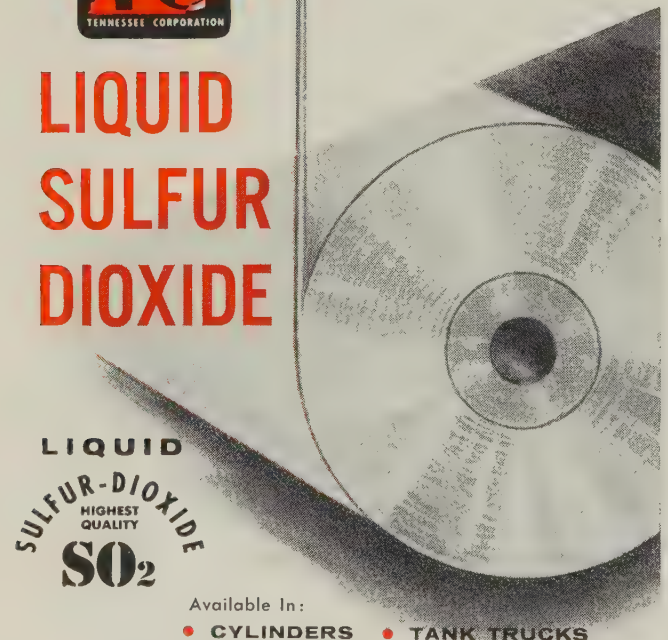

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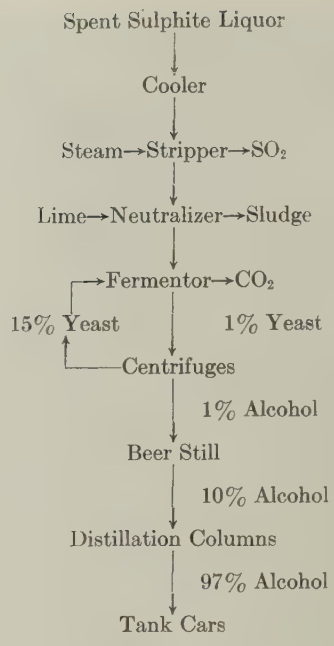


***Fig. 1. Ethyl alcohol from spent sulphite liquor***

the torula food yeast can utilize both pentoses and hexoses so that either hardwood or softwood liquors can be used.

Since raw sulphite liquor maycontain enough sulphur dioxide to inhibit yeast growth, it is usually necessary to reduce the sulphur dioxide concentration by stripping or neutralization before fermentation. Figure 1 shows an outline of the ethyl alcohol process. One mill in the United States, two in Canada, and many mills in Europe use this process. An outline of the torula yeast process is shown in Fig. 2. Two Wisconsin companies are now producing yeast for human food and animal feed by this process. The nutritional value of yeast depends primarily on the fact that it is about 50% protein, but the vitamin content is also high. However, yeast encounters severe competition in the animal feed market from soybean protein and synthetic vitamins. The only other commercial fermentation product from sul-

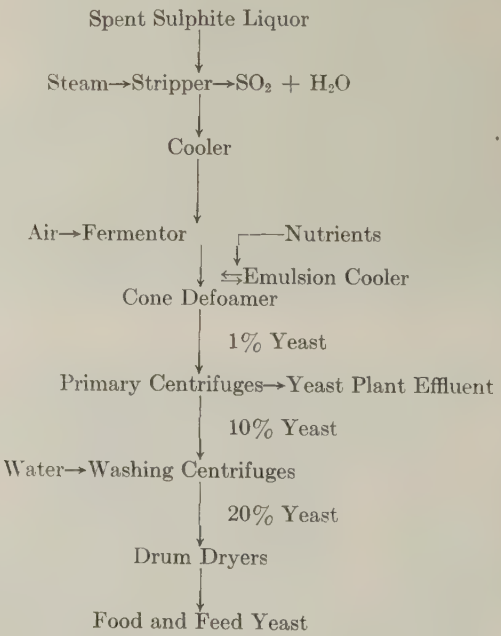


***Fig. 2. Food yeast from spent sulphite liquor***

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phite liquor, ethyl alcohol, can be synthesized at a lower cost from ethylene.

Even though the production of yeast or ethyl alcohol alone is not economical, the over-all fermentation process has additional credits which improve the picture considerably. In the first place, the amount of biochemical oxygen demand in the fermented liquor has been drastically reduced so that it can be discarded with less danger of overloading the streams. Another credit is the sulphur dioxide which can be recovered in the stripping operation and used to prepare fresh cooking acid. Finally, the desugared lignosulphonates in the fermented liquor find better markets than the whole liquor solids.

At best, the sugars act merely as diluents of the lignosulphonates in most applications for which the lignosulphonates are suited. In some cases, though, they may interfere with a desired adsorption of the lignosulphonates. Finally, they can interfere chemically by using up reagents in such a process as the production of vanillin. The hygroscopicity of the mixture of sugars could be either an advantage or a disadvantage, depending upon the particular use. Removal of fermentable sugars reduces the growth of molds and improves the handling and storage characteristics of some products.

### CHEMICAL UTILIZATION

Chemically, the reducing sugars differ radically from the lignosulphonates. The former are low molecular weight compounds readily metabolized by a number of microorganisms and sensitive to decomposition by acids or bases. The lignosulphonates are primarily polymeric in nature, resistant to the action of microorganisms, and are not readily degraded by most chemical treatments. Chemically, they are in the aromatic family of compounds, whereas the sugars are aliphatic.

There are a number of methods of separating sugars and lignosulphonates in addition to fermentation. Ion exclusion or ion retardation provides a means of separating the ionic lignosulphonates and the nonionic sugar components of the liquor. Precipitation of the lignosulphonates in sulphite liquor with strongly alkaline aqueous solutions of lime in the Howard process converts the sugars to saccharinic acids, which remain in solution in the form of their calcium salts.

Another method of separating sugars from lignosulphonates is reactive solvent extraction, a process which is being developed by the League. Treatment of the dry sulphite liquor solids with certain organic solvents in the presence of an acid catalyst results in the formation of sugar derivatives, which are soluble in the solvent and can be separated from the insoluble lignosulphonates. Some of the lignosulphonates in the residue are soluble in aqueous solvent mixtures, and a fractionation of lignosulphonates can be obtained by additional extractions.

Mild treatment of dry sulphite liquor solids with methanol containing an acid catalyst results in a mixture of the methyl glycosides, which are soluble in methanol. The main portion of the nonsugars can then be filtered off. This procedure gives a mixture of the crude sugars upon hydrolysis and decolorization.


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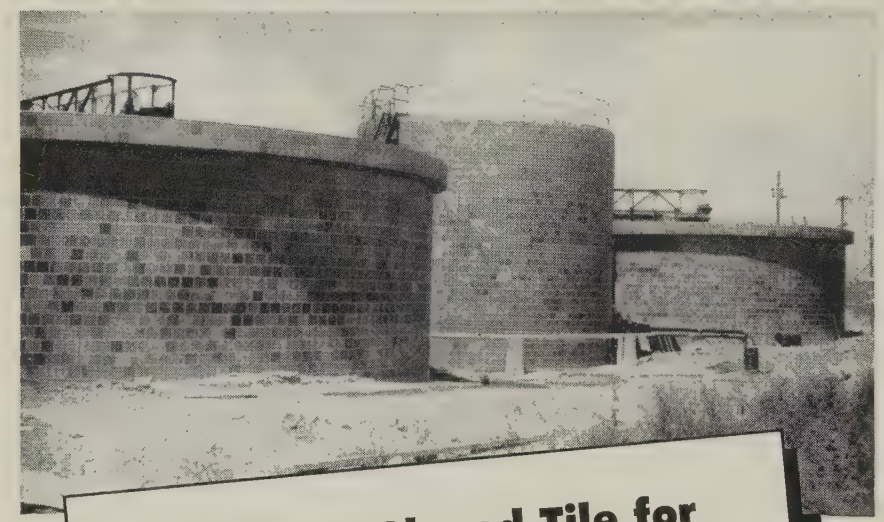

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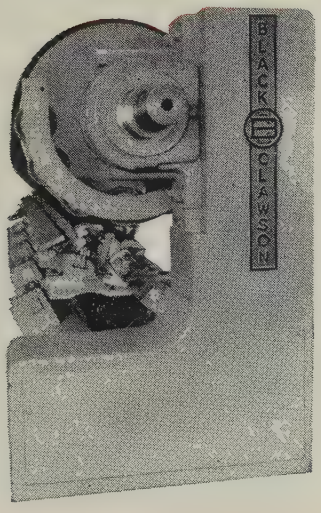


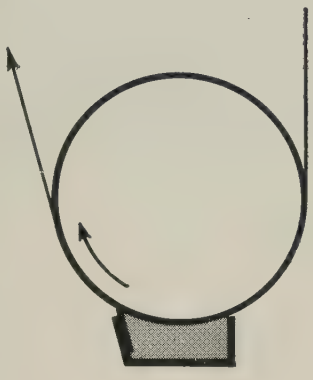

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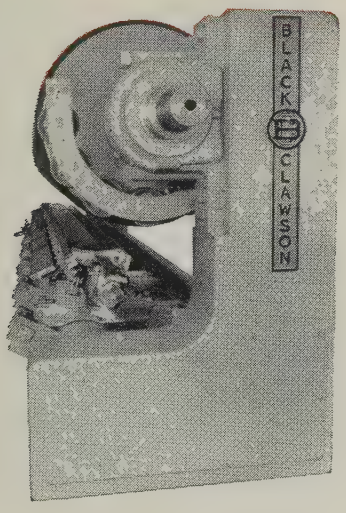


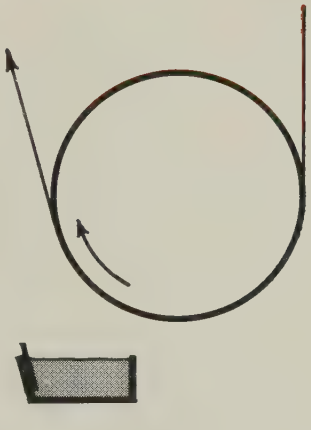

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The sugars in dried sulphite liquor solids will also react with acetone containing an acid catalyst to form diacetone derivatives. These are soluble in acetone, while the main portion of the nonsugars is insoluble and can be separated by filtration. This process can lead to the separation of crystalline D-xylose, L-arabinose, D-mannose, and D-galactose. The diacetone pentoses are slightly volatile with steam and can be separated by steam distillation from neutral aqueous solution.

Diacetone mannose is sparingly soluble in water and crystallizes directly from a concentrated aqueous solution of the crude sugar extract. Figure 3 shows the structure of the diacetone derivatives of three hexoses. Diacetone mannose differs from the other diacetone sugars with which we are dealing in that it has a free reducing group and can undergo such characteristic reactions of the free sugars as reduction to the diol, oxidation to the aldonic acid or its lactone, glycoside formation, and alkaline degradation.

The presence of the two free hydroxyl groups at the 1 and 4 positions suggests the possibility that diacetone mannitol might be used to produce polyesters. Removal of the acetone groups by acid hydrolysis would make additional hydroxyl groups available for cross linking.

Mannitol is being produced commercially from glucose and has a number of uses. Sodium gluconate has been offered commercially as a sequestering agent for calcium to give sparkling clean glassware when used in washing compounds. sodium mannonate could be even more effective for this purpose. Methyl glucoside has been proposed for use in the compounding of resins. Xylose is not metabolized by humans and might be useful as a sweetening agent in diabetic foods, although there is some evidence of undesirable side reactions. Treatment with acid will yield furfural from pentoses and levulinic acid from hexoses. There are many other possible uses of the sugars or sugar derivatives which will not be mentioned here.

In Fig. 4, the importance of a good balance between sugar products and lignosulphonate products is shown. Here can be seen an example of the general relation between the selling price of lignosulphonates and the price which must be obtained for sugar products to maintain

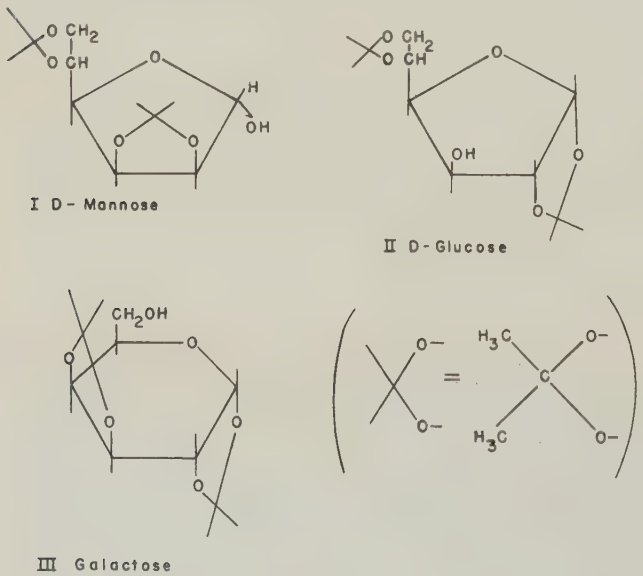


*Fig. 3. Di-O-isopropyldene derivatives of spent sulphite liquor hexoses*

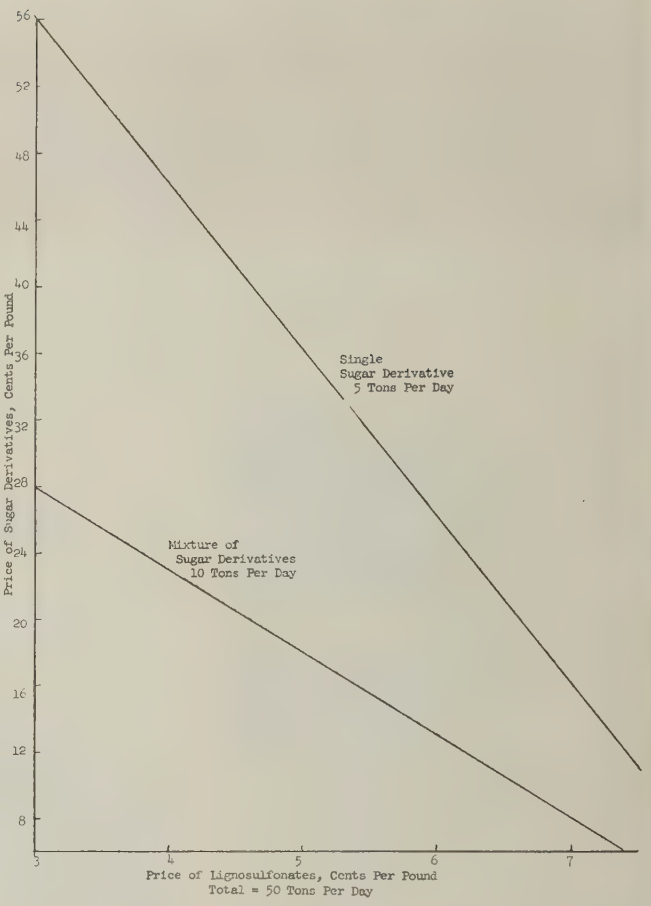
Price of Sugar Derivatives, Cents Per Pound
Single Sugar Derivative 5 Tons Per Day
Mixture of Sugar Derivatives 10 Tons Per Day
Price of Lignosulfonates, Cents Per Pound
Total = 50 Tons Per Day

***Fig. 4. Relation between selling price of lignosulphonates and price of sugar derivatives required to obtain a constant net income***

a constant net income. The lignosulphonates will normally be produced in quantities from five to ten times greater than the sugar products. From the curves it can be seen that each cent per pound increase in the price of the lignosulphonates will serve to improve the competitive position of the sugar products by reducing the cost of the sugar derivatives 5 to 10 cents per lb.

Recognition of the interdependence of lignin and sugar fractions and the need to recover all possible values in the development of an economically successful utilization process for spent sulphite liquor correlates with a general trend in the planning of research on industrial wastes. After many years of research, probabilities no longer favor the finding of single, small-volume specialty products derived from a relatively small portion of the overall waste which could alone be expected to support the high costs of handling and processing the total waste. Today's trend toward team research, therefore, finds a number of organizations attacking the spent sulphite liquor problem with effort directed toward long-term, planned development of integrated processes to yield a variety of by-product values from both the lignin and sugar fractions of spent sulphite liquor. This pathway predicates the use of many research skills in chemistry, in engineering, and in market development before finished processes will evolve with reasonable over-all costs, low individual product cost, and sufficient market outlets to justify plant construction.

Presented at the American Chemical Society Meeting, San Francisco, Calif., April 14, 1958.

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# Fungus Losses in the Paper Industry and Related Research Needs

R. A. ZABEL

FIVE important types of loss are caused by fungi in the pulp and paper industry. I plan to summarize the current status of each problem and emphasize major research needs in this brief talk.

Since we are to discuss losses in the mill caused by filamentous fungi, a brief review of these microorganisms with emphasis on several unique biologic capabilities is in order as a general background.

*What the fungi are*—Fungi are filamentous, dependent, thallus plants microscopic in size. Special reproductive structures are formed which produce enormous numbers of microscopic cells known as spores. The importance of fungi in nature is well-known. We realize their great positive biologic roles in the carbon cycle, the nitrogen cycle, the beneficial symbiotic associations with tree roots, and digestion in animals, to name a few. Their major disadvantages are as causual agents of disease and premature death to plants, animals, and man, and the deterioration or deleterious change of organic materials.

*Unique biologic capabilities*—Fungi possess several characteristics which give them unusual biologic potentials. In order to understand and to control fungi more effectively, we will review some of their unusual capacities. Many fungi produce enormous numbers of spores in short periods of time. The formation of literally billions of spores coupled with effective dissemination due to small size, results in an unusually high reproductive potential.

Many of the common fungi, e.g., molds, may be considered for practical purposes as omnipresent. They are found so commonly that their presence is almost assured in a specific substratum when growth conditions become satisfactory.

Each spore can be considered a potential new organism. Mutations or changes in physiologic capabilities due to alteration in gene structure are estimated to occur in fungi at the rate of about 1 per billion to 10 billion organisms. A high percentage of these gene changes are deleterious to the organism and may cause its sudden or eventual death. Other gene changes enable the organism to cope more effectively with its environment hence survival chances are increased. In fungi, with their short-life cycles and the huge numbers of reproductive units or spores produced, we find the capacity to change, mutate, or in effect, adjust to changing conditions greatly accelerated when compared with higher organisms. This gradual evolution or change in microorganisms is extremely important to mankind and may appear in the form of increased resistance of bacteria to antibiotics, slime-forming organisms to slimicides, or the development of new virulent strains of pathogens.

Approximately 100,000 different kinds of fungi are estimated to occur. Of those known, many show great variation in their optimum growth requirements and enzymatic capacity to utilize organic materials as food. This means that many fungi may be favored to develop under the specific conditions of commercial processes involving organic substrates, such as pulp.

Fungi require certain specific conditions and materials for growth. It is emphasized that their growth results in decay, disease, discoloration, and slime formation in our field. The major growth needs are listed as follows:

1. Favorable temperature (20–30°C.).
2. Water—free water in the cell lumen or water above the fiber saturation point (25–32% of wood).
3. Oxygen—free atmospheric (less frequently molecularly bound oxygen).
4. Food—carbohydrates, proteins, or fats as a source of energy and basic raw materials.
5. Miscellaneous—a favorable pH, presence of certain minor metals or specific vitamins.

With this brief review of the nature, the growth needs, and the unique capabilities of filamentous fungi, let us consider five important losses caused by fungi in the pulp and paper industry. These losses are tree diseases, heartrots, pulpwood and pulp deterioration, the formation of slime in the mill, and the decay of mill buildings and associated wooden structures. We will briefly discuss the current status of these subjects with emphasis on research needs.

## DISEASES OF PULPWOOD SPECIES

A few of the common diseases of eastern and southern

**Table I. Common Forest and Plantation Diseases of Several Northeastern and Southern Pulpwood Species (5, 24)**

| *Pulpwood Species*[a] | *Pathogen* | *Common name of disease* |
|---|---|---|
| Balsam fir | *Cytospora* sp. | Cytospora canker |
| Balsam fir | ———[b] | Balsam fir mortality |
| Red spruce | *Cytospora kunzei* | Cytospora canker |
| Black spruce | *Arceuthobium pusillum* | Dwarf mistletoe |
| Poplar species | *Hypoxylon pruinatum* | Hypoxylon canker |
| Poplar species | *Nectria galligena* | Nectria canker |
| Birch species | *Nectria galligena* | Nectria canker |
| Yellow birch | ———[b] | Birch dieback |
| American beech | *Nectria coccinea* var. *faginata* | Beech bark disease |
| Sugar maple | *Eutypella parasitica* | Eutypella canker |
| Slash pine | *Cronartium fusiforme* | Southern fusiform rust |
| Longleaf pine | *Scirrhia acicola* | Brown spot needle blight |
| Conifers | *Fomes annosus* | Fomes root rot |

[a] Common names of trees are taken from the checklist of native and naturalized trees of the United States by Little (*16*).
[b] Noninfectious diseases and diseases of unknown cause are indicated by a solid line. Scientific names of pathogens are taken from Boyce (*5*).

R. A. ZABEL, Chairman, Department of Forest Botany and Pathology, State University College of Forestry at Syracuse University, Syracuse, N. Y.

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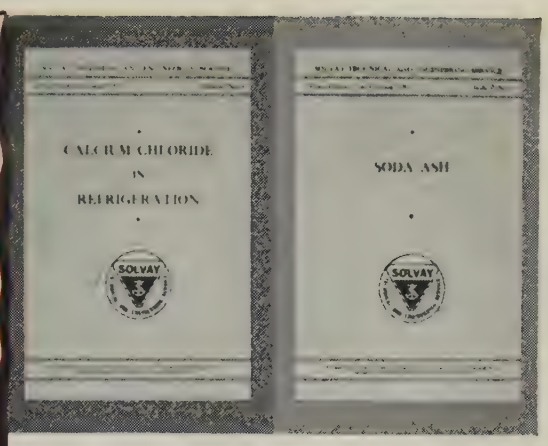


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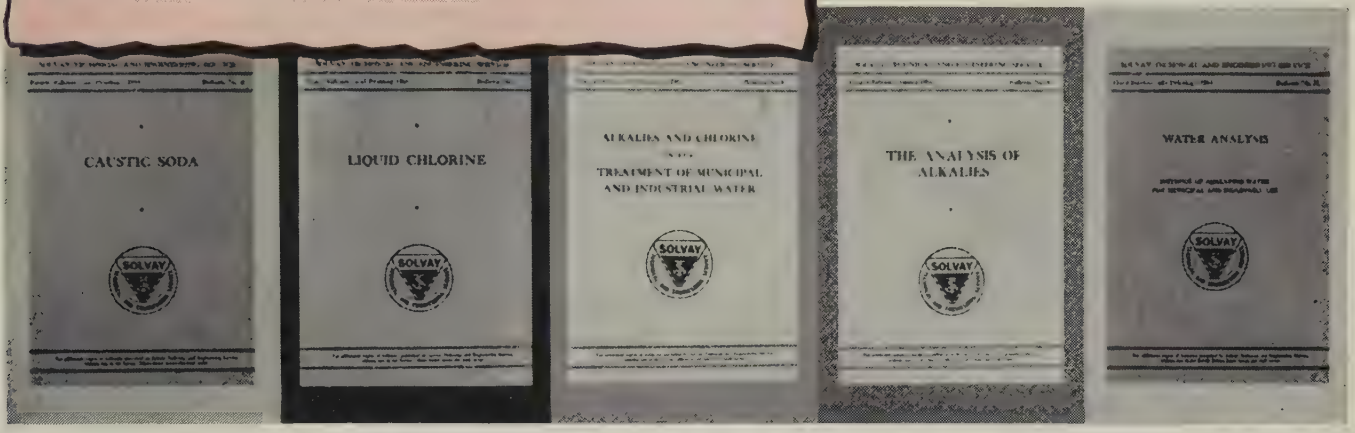


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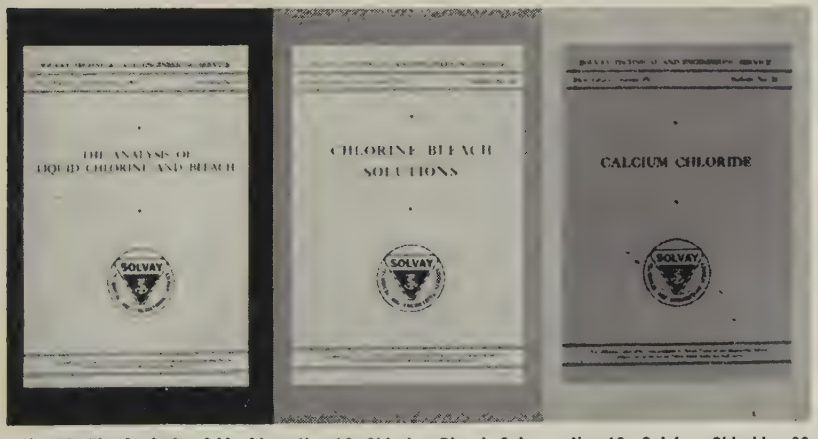


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pulpwood species are listed in Table I. Only a few companies in this region are involved with the management of their own forest lands, so we will limit ourselves to several general comments on this subject. The major diseases of pulpwood species are described in forest pathology textbooks (*2, 5*). Disease losses are carried currently by the land owner and transferred to the paper industry eventually in pulpwood price. It can be predicted that in the future, tree disease problems will become increasingly severe in our artificially established plantations concentrating on a single or limited number of species. It is important to remember in the current search for trees of rapid growth, long fiber length, and high specific gravity that disease resistance may be a major limiting factor. The serious susceptibility of hybrid poplar to several diseases and slash pine to the fusiform rust stresses the importance of disease resistance in tree improvement programs.

We need information on the relative importance of various pulpwood tree diseases, their locations, rates of spread, intensities, and tree mortality. Intensified research is needed on controls of our major pulpwood tree diseases by government, industry, and university forest pathologists.

## HEARTROTS IN PULPWOOD SPECIES

This is another broad subject with many important facets which we can only briefly outline. Important heartrots in northeastern pulpwood species are summarized in Table II by host species and rot types. Descriptions of the important tree rots are presented in forest pathology textbooks (*2, 5*).

Heartrot is a major tree disease problem. Losses from heartrot in sawtimber alone have been estimated to be 13.3% the volume of our standing sawtimber (*5*). Heartrot losses in many pulpwood species are estimated to exceed this figure. Some of our best pulpwood species prove unusually susceptible to heartrot at an early age. In addition to reduction in pulpwood weight yields, heartrot decreases floatability and significantly reduces pulp yields and quality. The important effects of heartrot on pulp yields and characteristics are discussed in the next section.

**Table II. Common Heartrot Fungi of Several Northeastern Pulpwood Species (*1, 5, 21, 24*)**

| *Heartrot fungi*[a] | *Type of decay*[a] | *Pulpwood host(s)* |
|---|---|---|
| | Conifers | |
| *Fomes pini* | White pocket rot | Conifers |
| *Polyporus schweinitzii* | Brown cubical butt rot | Conifers |
| *Stereum sanguinolentum* | Brown trunk rot | Balsam fir (other conifers) |
| *Poria subacida* | White feather rot | Balsam fir (other conifers) |
| *Polyporus balsameus* | Brown cubical rot | Balsam fir (other conifers) |
| *Corticium galactinum* | White butt rot | Balsam fir |
| *Coniophora puteana* | Brown cubical rot | Balsam fir |
| *Fomes roseus* | Brown cubical rot | Conifers |
| | Hardwoods | |
| *Fomes igniarius* | White trunk rot | Hardwoods |
| *Poria obliqua* | White trunk rot | Birches |
| *Polyporus glomeratus* | White trunk rot | American beech and maples |
| *Fomes applanatus* | White mottled rot | Hardwoods |
| *Fomes connatus* | Soft white rot | Sugar maple |

[a] Scientific names of heartrot fungi and types of decay are taken from Boyce (*5*).

The percentage of decay in purchased pulpwood is too high. Pulpwood should be purchased according to rigid decay specifications.

Our research needs on heartrot in pulpwood species are many. We need to locate or develop in the years ahead strains of pulpwood species which are resistant to heartrots. We need to develop silvicultural practices which will reduce heartrot development. Accurate cutting rotations and cull percentages at various tree ages should be known for our major pulpwood species. Information on pulp yields and paper quality from specific kinds of decay in pulpwood are vitally needed to guide us in the development of sound pulpwood purchase specifications.

## PULPWOOD DETERIORATION DURING STORAGE

Decays and discolorations which develop in pulpwood during prolonged storage periods present many serious problems. A few of the common fungi reported as associated with decaying pulpwood during storage in the Northeast are listed in Table III. It is generally realized that the decay losses are large though not accurately quantitated. It is predicted that these estimated losses will increase with the growth of hardwood pulping.

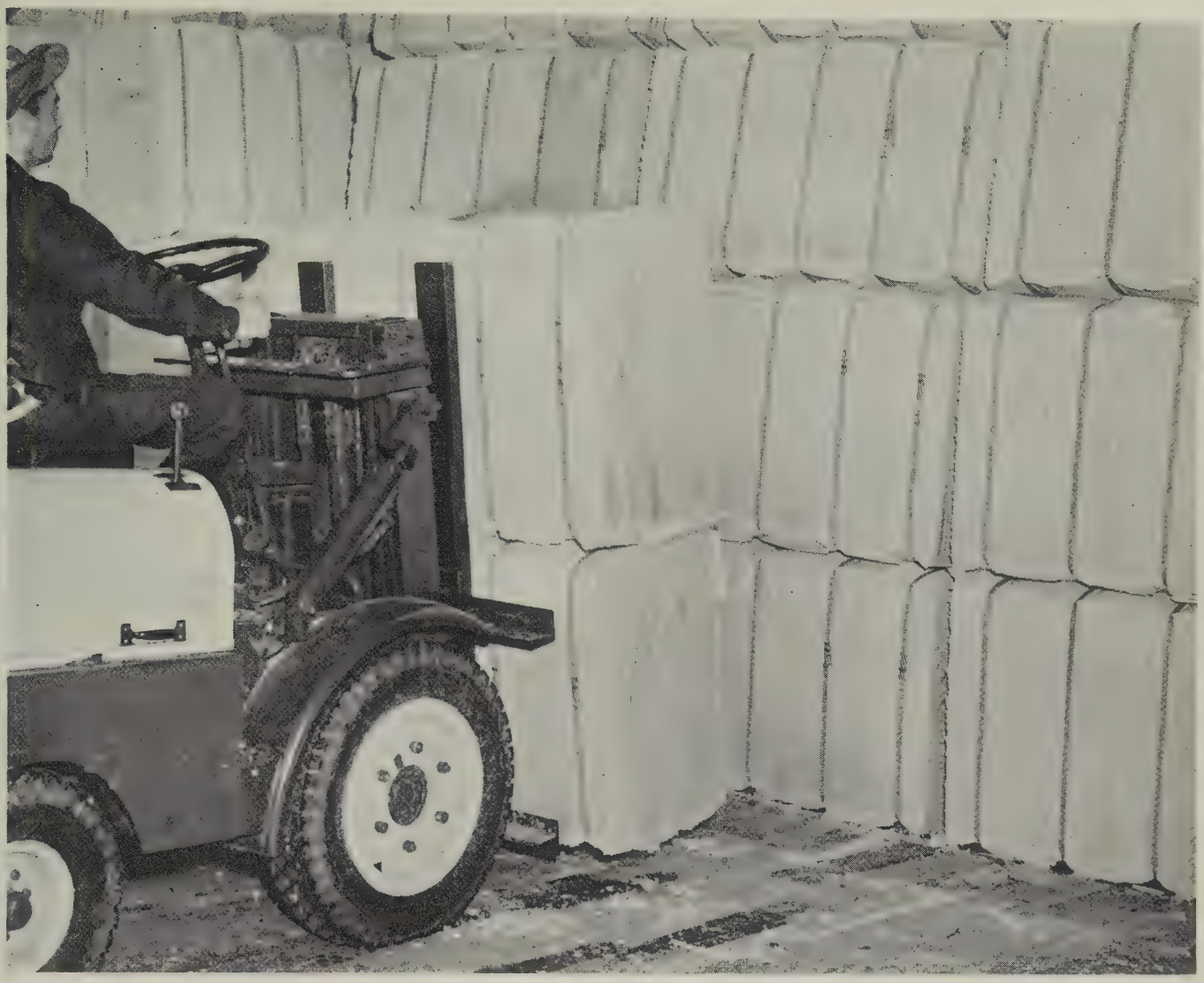
**Table III. Common Weed-decay Fungi Reported Associated with the Decay of Pulpwood During Prolonged Storage (*5, 13*)**

| *Pulpwood rotting fungi*[a] | *Type of decay*[a] | *Pulpwood substrata* |
|---|---|---|
| *Lenzites saepiaria* | Brown cubical rot | Conifers |
| *Polyporus abietinus* | White pocket rot | Conifers |
| *Stereum sanguinolentum* | Brown rot | Conifers |
| *Peniophora gigantea* | White rot | Conifers |
| *Fomes roseus* | Brown cubical rot | Conifers |
| *Fomes pinicola* | Brown cubical rot | Conifers |
| *Lenzites trabea* | Brown cubical rot | Conifers and hardwoods |
| *Polyporus versicolor* | Soft white rot | Hardwoods |
| *Polyporus adustus* | White rot | Hardwoods |
| *Polyporus pargamenus* | White pocket rot | Hardwoods |
| *Polyporus hirsutus* | Soft white rot | Hardwoods |
| *Schizophyllum commune* | White rot | Hardwoods |

[a] Scientific names of wood-decay fungi and types of decays are taken generally from Boyce (*5*).

Bjorkman has shown that pulpwood losses in Sweden may reach 15 to 20% after 3 years of storage. Lindgren reports losses from 11 to 15% in our native southern pines in 1 year of storage. Pascoe and Scheffer report 10% reductions in yield of rough jack pine stored 26 months in the Lake States. It is surprising that our regional storage losses in the Northeast for various pulpwood species are not accurately known and are actually minimized by many. The prevalent practice of buying wood by the cord and selling paper by the ton aids in the concealment of this important source of fiber loss. In addition to the impressive weight losses per cord, there are deleterious chemical changes in the decayed wood which further reduce yields and pulp quality.

A brief review of wood decay from a chemical viewpoint will emphasize these significant changes in pulp and paper properties. Wood decay is slow digestion of cell wall material by the exoenzymes secreted by the hyphae of fungi. The two major chemical actions involved in the chemical destruction of cell wall material are hydrolysis and oxidation. Wood



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decay fungi which primarily attack the holocellulose component of the cell wall by hydrolysis cause brown rots. White rot organisms attack all cell wall components, holocellulose by hydrolysis and lignin by oxidation. Various white rot organisms may consume certain wood components selectively in different time sequences. For example, some attack the lignin first whereas others initially destroy the pentosans. The effects of these two types of decay fungi on wood components are shown in Table IV. These general data indicate clearly why the strength of paper from decayed wood is low and excessive losses occur during beating. They also explain the high alkali solubility or excessive losses of carbohydrates which are flushed down the drain and intensify biochemical oxygen demand problems. They explain why brown rotted wood is a pulping liability and can only increase dirt counts. The acidity of decayed wood explains the increased alkali consumption associated with pulping decayed wood. The weight losses in decayed wood demonstrate reason for bulking problems associated with its use in digesters.

A related problem is presented by the staining fungi growing on stored pulpwood that significantly decrease pulp brightness. Reports indicate that 10% increases in the bleach consumption are required frequently to bring stained pulpwood to acceptable brightness in various pulps. We can anticipate an increase in discoloration problems with the trend to chip storage. In a mild positive sense stain and mold contaminations in pulpwood may increase the ease of wood penetration by chemicals used in the chemigroundwood process.

**Table IV. A Comparison of the Effects of a Brown-rot Fungus and a White-rot Fungus on the Chemical Composition of Cell Wall Material (*22*)**

| *Chemical tests* | *Percentages based on O.D.W. of sound wood* | |
|---|---|---|
| | *Sound wood* | *Decayed wood* |
| Brown Rot[a] | | |
| Total 1% alkali solubility | 12.0 | 27.1 |
| Alcohol-benzene solubility | 0.6 | 2.0 |
| Cross and Bevan cellulose | 57.5 | 7.5 |
| Total pentosans | 9.4 | 3.7 |
| Lignin | 29.4 | 24.7 |
| Loss in weight due to decay | ... | 56.3 |
| White Rot[b] | | |
| Total 1% alkali solubility | 16.8 | 12.6 |
| Alcohol-benzene solubility | 2.8 | 1.4 |
| Cross and Bevan cellulose | 57.9 | 39.6 |
| Total pentosans | 22.8 | 15.5 |
| Lignin | 21.0 | 13.9 |
| Loss in weight due to decay | ... | 32.0[b] |

[a] The effects of the brown-rot fungus *Paxillus panuoides* on the wood of silver fir.
[b] The effects of the white-rot fungus *Polyporus versicolor* on the wood of red gum. The total weight loss value was approximated from the specific gravity loss data in the original article.

Our research needs here are again compelling. We need to quantitate our regional storage losses by pulpwood species and storage practices. We need to determine the best piling practices, safe periods of storage for various species, the best yard-handling practices for storage of various types of pulpwood. The effectiveness of fungicide spray treatments in extending storage periods should be considered. The feasibility of safe underwater storage with modern packet handling practices has been suggested (*14*). The effects of the major storage-rotting-fungi on pulping and paper properties need research. We might use the growth of colorless fungi in wood to increase penetration of refractory species. Basic studies on the chemistry of wood decay may be an important clue to more effective chemical pulping and lead us closer to understanding the chemical structure of wood.

## SLIME PROBLEMS

You are all generally informed on the causes, locations, the importance of slime formation in the paper mill, and the many direct and indirect ways it affects operations. I would like to stress that *fungi* are a common component in most mill slime flora. A few of the common species of fungi reported in mill slime are listed in Table V. Yeasts may produce sheets, membranes, or ropey strands of slime, and filamentous fungi form slimes of many types such as gellike masses, hard horny particles and granular dark masses (*18*). The acidity of many pulp systems with carbohydrate food sources presents a favorable environment for many fungi. Reports in the literature suggest that in some mills fungi may form the major slime component (*8, 11*). It may be that bacteria have been overemphasized in slime studies. Many of our laboratory procedures involving slime control have been developed primarily for bacteria by bacteriologists. I stress that the fungi are in general more resistant to slimicides than bacteria (Table VII). The full effects of fungi in altering pulp properties in view of their enzyme capabilities are not accurately known. We are just becoming aware of their importance in paper odor.

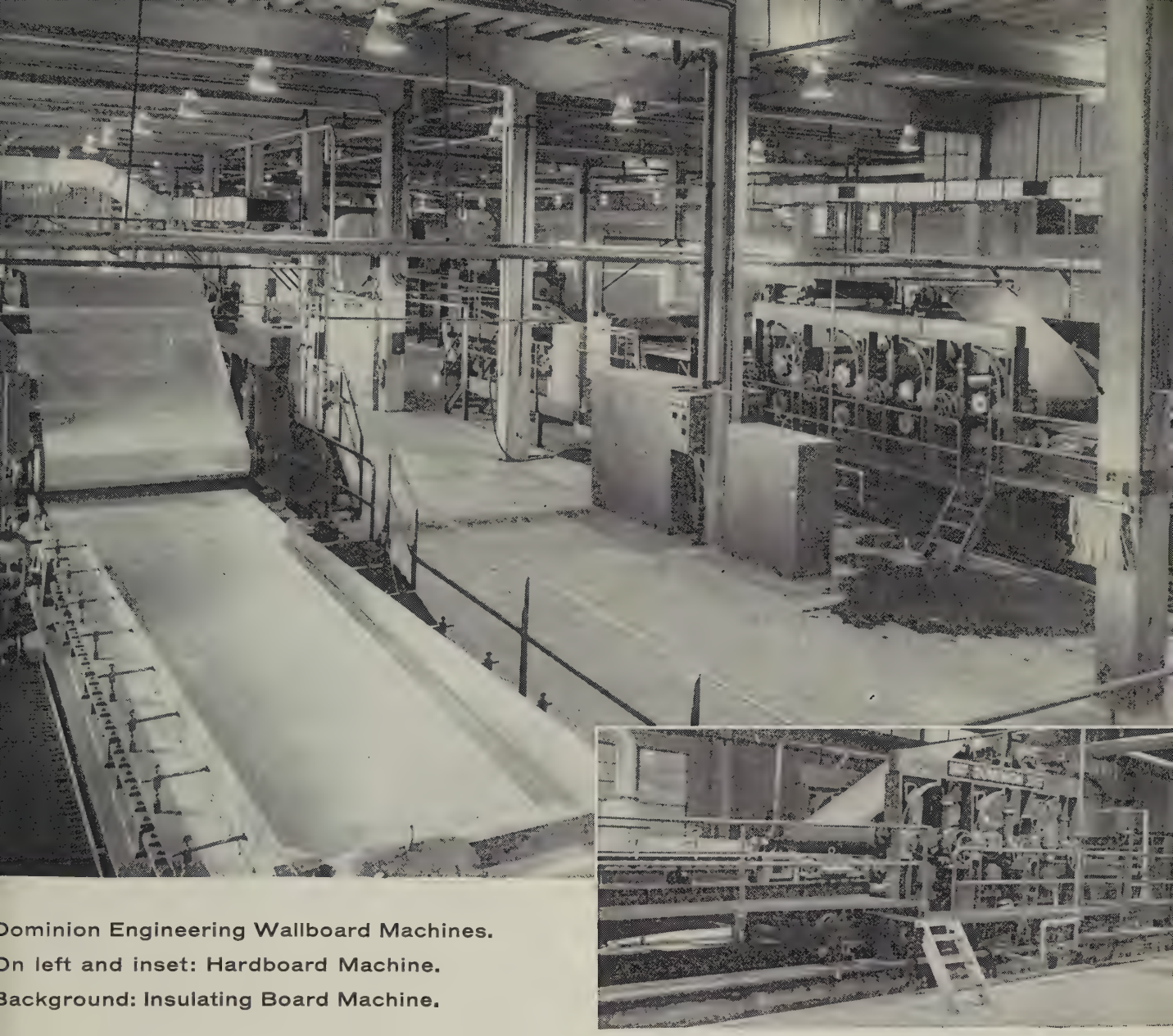
**Table V. A List of Various Genera of Common Fungi Reported as Associated with the Formation of Slime in Pulp and Paper Mills (*6, 11, 18*)[a]**

| *Genera* | *Genera* |
|---|---|
| Penicillium | Trichothecium |
| Aspergillus | Thamnidium |
| Fusarium | Gliocladium |
| Trichoderma | Clonostachys |
| Alternaria | Sporotrichum |
| Spicaria | Stachybotrys |
| Botrytis | Rhizopus |
| Citromyces | Mucor |
| Cephlasporium | Oidium |
| Acrostalagmus | Monilia |
| Chaetomium | Torula |
| Actinomyces | |

[a] The list of genera presented is based on a limited number of references; information on relative importance and frequency of occurrence in specific types of mills is largely unknown.

In my opinion, we may over-emphasize chemicals occasionally and adopt the modern "pill" phiolosophy in the control of our slime problems. Mill cleanliness or good housekeeping, chlorination of source water to low microorganism counts, and the periodic use of hot-toxicant-detergent solutions, are basic control steps which should be considered prior to chemical controls.

Our research goals in the slime problem area are many and varied. We need to know the relative importance of the principal slime-forming microorganisms associated with various types of mills. We need to know more precisely their effects on pulping and paper properties. Information is lacking on the many complex effects of various mill environmental



Dominion Engineering Wallboard Machines.
On left and inset: Hardboard Machine.
Background: Insulating Board Machine.

## Designed and produced by DOMINION:

Hardboard and Insulating Board Machines, installed at the Saskatoon Mill of the Prairie Fibreboard Company.

**DOMINION**–Canada's foremost supplier of Pulp, Paper and Board Machines since 1920.

PAPER DIVISION

**DOMINION ENGINEERING COMPANY LIMITED**

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The DRAPER Felt
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CANTON, MASS.

factors on microorganism populations. Data on the associations and interactions (synergism and antibiosis) among various slime-forming microorganisms are

**Table VI. Comparative Inhibition Levels of Several Slimicides and Toxicants to Two-common Test Bacteria and Two-filamentous Fungi (*20, 23*)**

| *Proprietary slimicide or toxicants* | *Inhibition level, p.p.m.* | | | |
|---|---|---|---|---|
| | *Bacillus mycoides* | *Aerobacter aerogenes* | *Aspergillus niger* | *Penicillium expansum* |
| BSM-11 | 3 | 25 | 25 | 25 |
| Buffen 30 | 0.8 | 6 | 20 | 30 |
| Lignasan | 1.6 | 10 | 40 | 15 |
| Santophen | 5 | 55 | 80 | 80 |
| Roccal | 7 | 200 | >3000 | >3000 |
| Silver cacodylate | 40 | 40 | 1000 | 900 |
| Methyl arsine oxide | <0.25 | <0.40 | <120 | <120 |
| 8-hydroxyquinoline methyl arsonate | 12 | 140 | 45 | 60 |

vital for the development of sound control programs. The development of more effective slimicides without paper use restrictions is an ever present challenge.

## BUILDING DECAY

Extensive exposed water surfaces, steam, and the inevitable condensation problems in buildings in our northern region present severe decay hazards in the wooden structures associated with pulp and paper manufacture. My advice in this general area is, where decay hazards are high, to follow the preservative and treatment recommendations formulated by the American Wood Preservers' Association. Major research needs in this field can be summarized to a continuation of the searches for more effective preservatives and wood treatment methods.

## SUMMARY

We have considered briefly the important current or potential losses in the paper industry caused by filamentous fungi. Major research needs leading to control and prevention are suggested for pulpwood tree diseases and heartrot, pulpwood deterioration during storage, slime formation, and building decay problems.

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Presented at the meeting of the Central District of the Empire State Section of TAPPI held in Syracuse, N. Y., Feb. 6, 1959.

# WHAT (you may ask) is a SALES ENGINEER from Stowe-Woodward?

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# Du Pont line of dyes and tinting colors meets all "white" needs

When a printer prints on white paper the blacks look blacker, the blues look bluer, the reds, yellows and pastels have more life and bounce if he prints on quality white paper that has been properly treated with Du Pont's optical brightener and/or tinting colors. These quality whites also make letters look better and easier to read—make tissue paper, toweling and waxed paper more attractive and more salable.

### THE LOOK OF QUALITY

That is why many paper makers are turning to Du Pont's recommendations to improve the brightness of their whites. And they are following them on a wide variety of papers. Magazine, book, newsprint, offset and envelope, as well as bonds and writings, can be enhanced with Du Pont optical brightener and tinting colors. Products are available for both beater and surface application. They can make any white paper look more attractive.

# news from Du Pont

### A DU PONT PRODUCT FOR ANY TYPE OF PAPER

Today, there is a Du Pont product that can help you to improve the appearance and brightness of any white paper.

Du Pont's basic dyes are used for newsprint and other ground wood base papers. They provide better whites at low cost.

Du Pont's direct dyes are especially suited for use in tissue, blotting and other unsized papers. They provide good whiteness at very reasonable cost, and can be used in some sized papers, too.

For most white papers "Halopont" tinting colors are recommended. These economical colors provide good lightfastness as well as "brightness" and are available in a wide shade range for all your tinting needs.

When the brightest possible white papers are desired, a combination of "Halopont" tinting colors and Du Pont Paper White BP is recommended.

For information on how to make whites better, write to: E. I. du Pont de Nemours & Co. (Inc.), Dyes and Chemicals Division, Wilmington 98, Delaware.

### HOW DO YOUR WHITES STACK UP?

This advertisement is printed on paper that was treated with Du Pont Paper White BP and "Halopont" Brilliant Blue 2 RN. Compare it with your own best "white" paper. See if it doesn't look more attractive . . . make the text easier to read . . . make the printed colors more pleasant . . . improve the whole appearance of the page.

Then call in a Du Pont representative and find out exactly how Du Pont products for the paper industry can help you.

# Paper White BP optical brightener and "Halopont"* tinting colors make the most attractive whites

Today the Paper Industry is using brighter and brighter pulps. But even these can be enhanced with a combination of Du Pont Paper White BP and "Halopont" tinting color. In fact, they produce the best results when used on the brightest pulps.

Both "Halopont" Blue RNM and "Halopont" Brilliant Blue 2 RN give excellent results in combination with Paper White BP optical brightener. Use one of these combinations for maximum attractiveness in *your* bright white papers.

### TECHNICAL SERVICE

On any question concerning your white grades of paper, call in a Du Pont Technical Sales Representative. He knows dyes; he knows paper; he knows your problems. He can help you and will be glad to.

# news from Du Pont

### NEW DU PONT LAB TO SERVE PACIFIC NORTHWEST

A new Du Pont paper laboratory is now in operation in Portland, Oregon. According to John Ayers, Du Pont District Sales Representative, the new laboratory facilities will enable him to give faster and still better technical service to paper mills in the Pacific Northwest. In rendering this new Du Pont service, Mr. Ayers will be assisted at this facility by Mr. Ferd Ahl, an experienced Du Pont Technical Service Representative.

This service will include color matching, development of dyeing formulations and help on application problems. As before, John will also have at his disposal the complete facilities of the Du Pont Technical Laboratory at Deepwater, N. J.

If your mill is located in this area, refer your paper coloring problems to this new Portland technical service laboratory. It is there to help you. The address: 1238 N.W. Glisan Street, Portland, Oregon.

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*DYES AND CHEMICALS*

**BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY***

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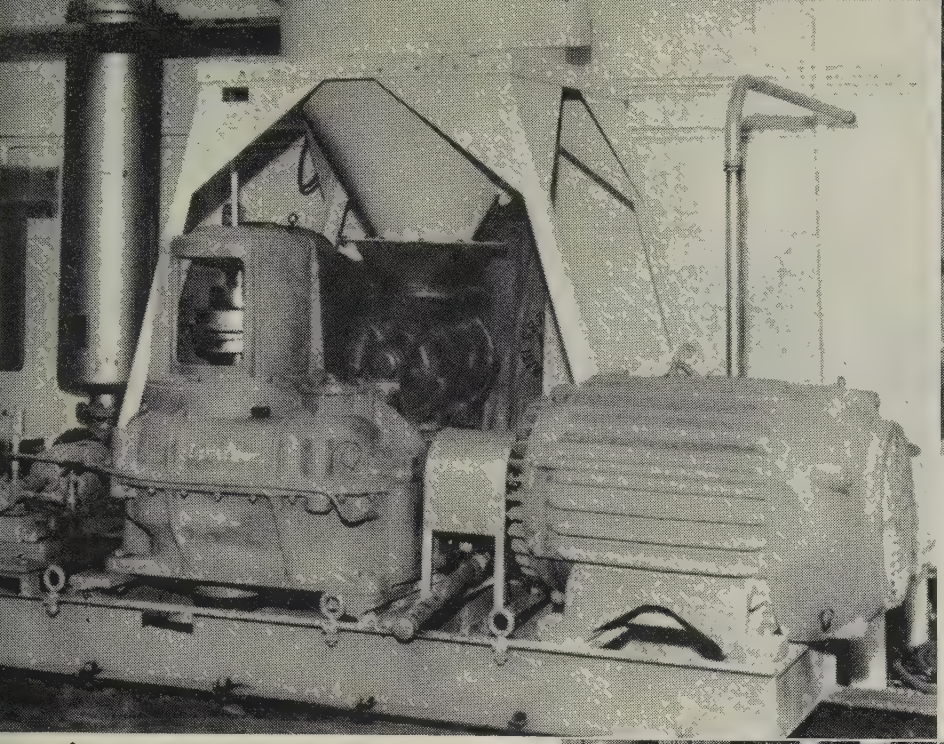
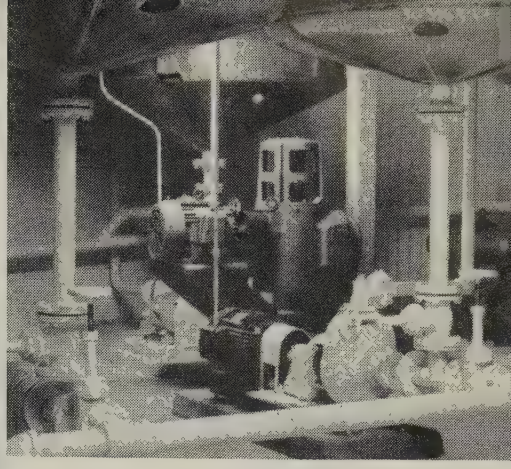
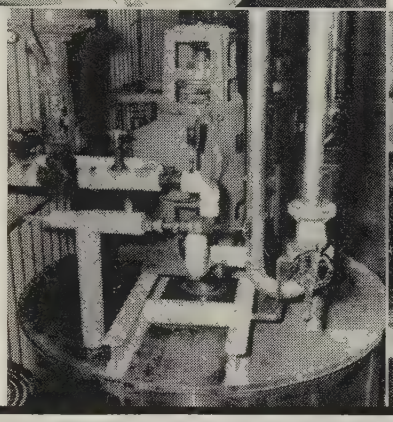




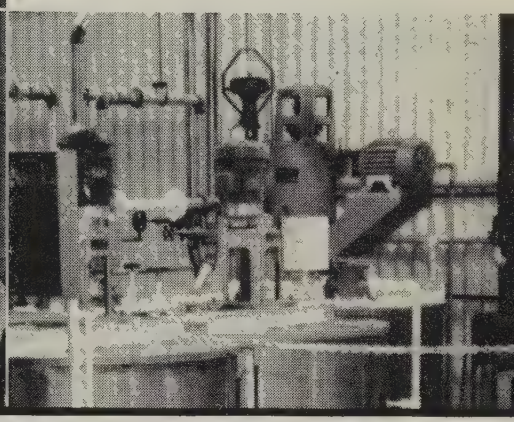
**CLAY SLURRY** at 71% solids waits in five 120-ton storage tanks, held in uniform suspension by 10-hp LIGHTNIN Mixers.

**STARCH MEETS WATER** in 1,000-gallon tanks. Then clay slurry is charged, reducing solids to 52-58%. A 3-hp propeller-type LIGHTNIN Mixer in each tank assures consistent density of feed to continuous cooker.

**MAKEDOWN** One 75-hp LIGHTNIN Mixer slurries 50 tons of dry clay—a hopper-car load—as it feeds into dispersion tank at 12.5 tons per hour.



**HIGHLY THIXOTROPIC** clay-starch slurry from cooker turns over in two tanks equipped with 10-hp LIGHTNIN Mixers. Then it moves to 1,000-gallon storage tanks where 5-hp LIGHTNIN Mixers keep it thoroughly blended to prevent crusting before use.



# One man, 20 mixers clobber cost of coatings

Designed to handle clay in bulk as a slurry, this new mixing system at Blandin Paper Company, Grand Rapids, Minn., helps in four ways to prepare coatings at record low cost.

1. The system itself cost much less to build than comparable coating facilities.

2. It permits the purchase of lower-cost bulk clay.

3. Ended are the problems of space-wasting dry storage, handling of bags, and dust. Clay is always ready for immediate use.

4. One man per shift handles all operations—with the help of 20 LIGHTNIN Mixers ranging in size from 3 to 75 hp.

### What mill management says

"We knew that mixing was going to be a vital part of our new process," says Harold F. Zigmund, Blandin's vice-president in charge of manufacturing. "We required equipment that was sound and could give us the process result we were looking for.

"LIGHTNIN Mixers have enabled us to accomplish both of our goals. The cooperation and service we have obtained from the MIXCO field representative have been most helpful to us."

Since completing the new coatings plant, Blandin has decided to use LIGHTNIN Paper Stock Agitators on the mill's three brown-stock chests, a neutralization chest, and a broke chest.

Guaranteed mixing performance can mean savings for you, just as it does for Blandin. And it's easy to get. At a call from you, an experienced LIGHTNIN Mixer representative can size up your needs and help you select precisely the right mixing system to deliver the results you want.

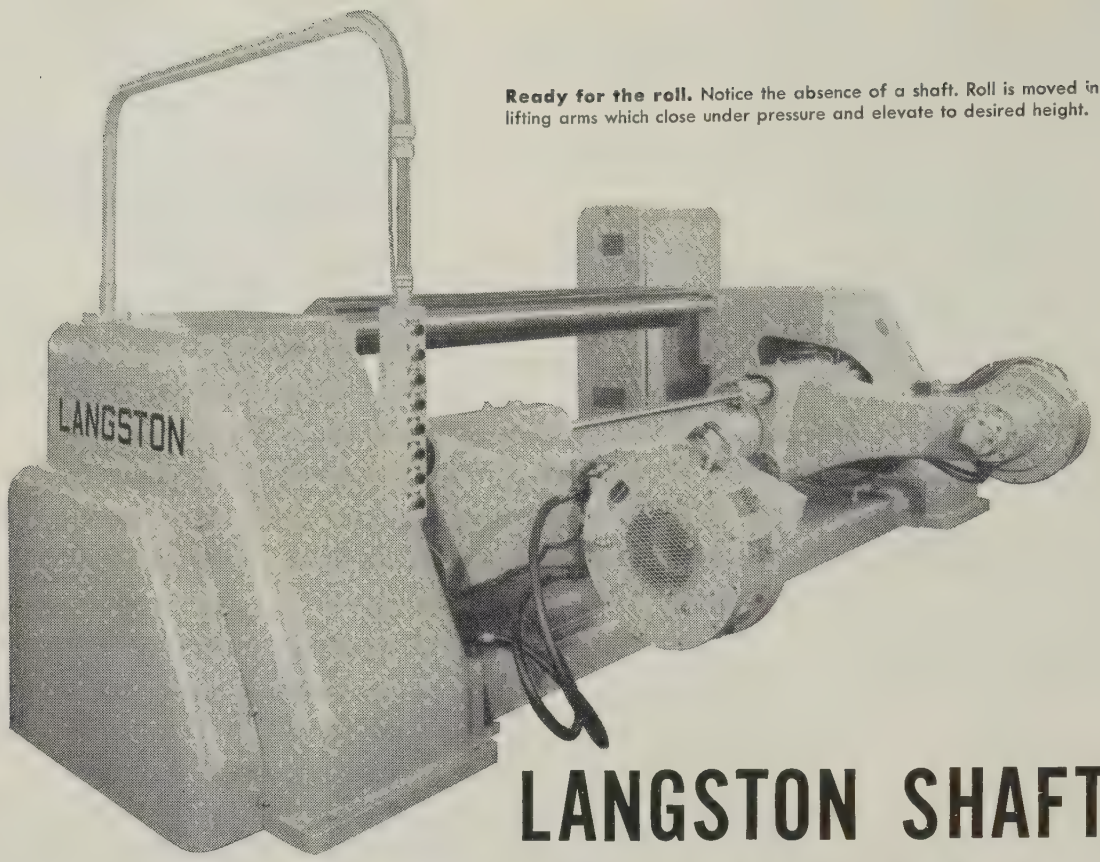
He draws upon the experience of thousands of test runs, and successful installations in several hundred mills. He offers you widest possible choice of *standard* power-speed combinations and mixer designs. Call him in now (he's listed in Paper & Pulp Mill Catalog). Or write us direct.

**Lightnin® Mixers**

**MIXCO fluid mixing specialists**

**MIXING EQUIPMENT Co., Inc., 142-e Mt. Read Blvd., Rochester 3, N.Y.**

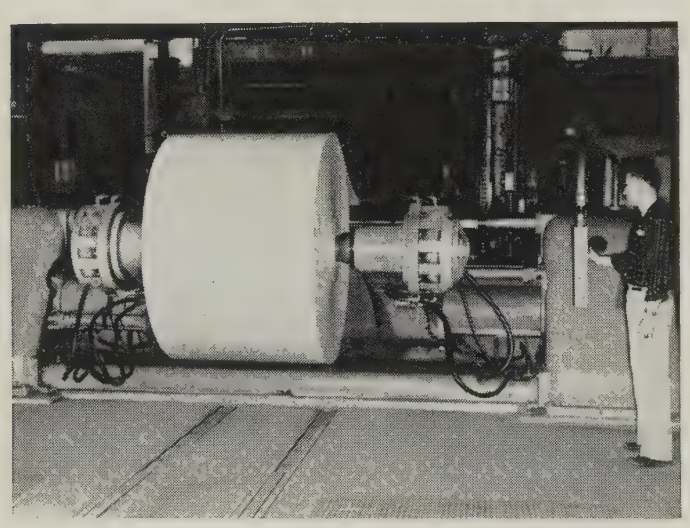
*In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Ave., Toronto 19, Ont.*




**Ready for the roll.** Notice the absence of a shaft. Roll is moved in between lifting arms which close under pressure and elevate to desired height.

# LANGSTON SHAFTLESS UNWIND STAND

## Boost your production . . . reduce your slitting and rewinding costs

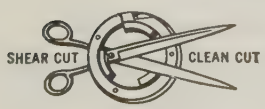


**Easy, fast, completely safe.** One man does everything. Operating push-button controls, he closes lifting arms, elevates roll, sets brakes.

One man can load the heaviest roll. No heavy shaft to handle. No cone tightening. No couplings to engage. No crane lifting. Just pushbuttons. This is the Langston heavy duty shaftless unwind stand for rewinding and converting applications.

You not only save time, you also get better unwinding. Roll can be positioned laterally by push-button control—even when the machine is running. It's held firmly under pressure for complete safety throughout the unwind. Several braking arrangements can be provided to handle a wide range of grades and conditions. Available extras provide for handling very narrow rolls; for constant tensioning; for automatic braking of idler rolls; for automatic web alignment and side register control; for web oscillation; and for local or remote control.

This new Langston shaftless unwind stand can be used with any make of slitter. Available for maximum roll widths from 40 to 132 in. and diameters from 14 to 84 in. Speeds to 3000 fpm and higher. For complete information, write Samuel M. Langston Co., Camden 4, N. J.




LANGSTON Leadership...by design

# No. 1 Requirement: Quality

## Here's How a Mill Kept It... And Saved $.95 per Paper Ton!

### Cash savings on size requirements multiplied by power savings, cleaner machines, better retention

Fine writing paper production can not take process short-cuts which affect quality . . . so this instance of Nalco Sodium Aluminate performance is more than a cost-cutting story—sheet specifications were considerably improved with Nalco 680 Sodium Aluminate—on top of all the other advantages!

### Facts from Figures

This is the way the chemical costs work out on a "per ton" basis:

| | |
|---|---|
| Size Requirements (without Nalco Sodium Aluminate)... | 30.25 lb. |
| Size Requirements (with Nalco Sodium Aluminate)... | 21.60 lb. |
| Pounds of Size Saved... | 8.65 |
| Alum Requirements (without Nalco Sodium Aluminate)... | 40.00 lb. |
| Alum Requirements (with Nalco Sodium Aluminate)... | 30.00 lb. |
| Pounds of Alum Saved... | 10.00 |
| Savings on Size (at 15.3 cents per lb.)... | $ 1.32 |
| Savings on Alum (at 2.2 cents per lb.)... | .22 |
| | $ 1.54 |
| Less cost of Nalco Sodium Aluminate (at 10.7 cents per lb.)... | .59 |
| ***TOTAL NET SAVING, per ton of paper*** | **$ .95** |

Add to the dollar savings above: more fines and furnish kept in the sheet; more rapid reaction time to cut soluble alumina losses in the white water; higher pH to give means of adjusting size-alumina-pH ratio, and to cut corrosion damage; lower power requirements and cleaner machines.

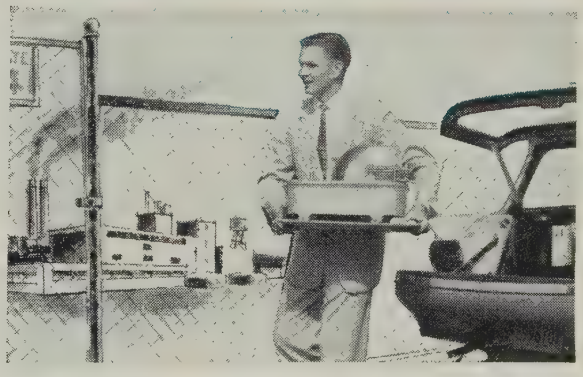
Nalco Sodium Aluminate is a concentrated package of stable, soluble alumina and alkalinity that produces positive advantages all along the line!

### Paper Quality Improved

Nalco Sodium Aluminate not only produces spectacular figures in processing savings, but also improved sheet specifications in the mill whose alum-aluminate costs are given above: *Size ratings jumped from a range of 45-50 up to 50-60. Ash content went from 5.6-5.8% to 7-7.1% !*

Other quality improvements include: better aging, folding endurance, burst strength, workability and reduced brittleness.

### Action When It Is Needed



Results with Nalco Sodium Aluminate—and every other Nalco chemical used in paper processing—are backed by Nalco Field Service Men whose experience and willingness to help can be of real value to you . . . whether the situation calls for emergency action or long-range planning for better paper products at lowest possible production costs.

For action that leads to results like these in your mill, call your Nalco Field Service Man, or write:

**NATIONAL ALUMINATE CORPORATION**
**6216 West 66th Place** • **Chicago 38, Illinois**
*Subsidiaries in Venezuela, Italy, Spain and West Germany.*
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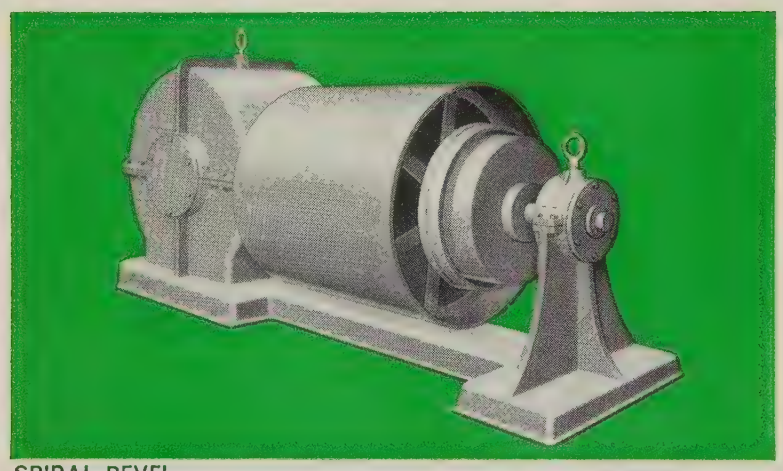
*...Serving Industry Through Practical Applied Science*

Nalco CHEMICALS

BELOIT UNIT MODERNIZATION

# Rugged Beloit Drive Units

**MODERNIZATION**
**WITH PROVED BELOIT UNITS**
**...CUTS COSTS**
**...INCREASES SPEED**
**...IMPROVES QUALITY**



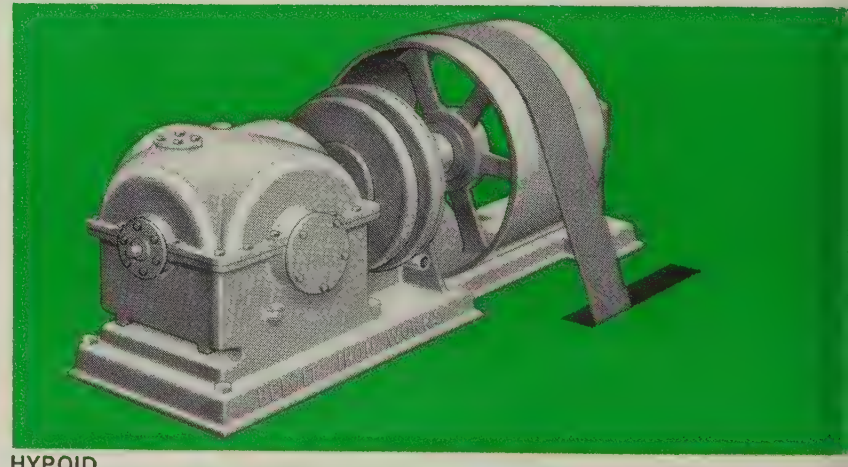
SPIRAL BEVEL

### Modest horsepower requirements?

If horsepower requirements are modest, consider the Beloit spiral bevel drive arrangement. This drive is particularly suited to the moderate-speed machine requiring relatively low horsepower. This simple, economical drive embodies top-quality components and is designed for efficient operation over a wide range of weights and draw conditions. A rugged, low-priced unit with a fine performance record.

### High horsepower requirements?

Beloit's rugged hypoid drive units are designed to carry high horsepower. This drive has given outstanding performance on wide machines running in the upper speed ranges. New design features have added to the inherent advantages found in this particular drive arrangement. Hypoid units can be driven from basement or overhead lineshaft setups.



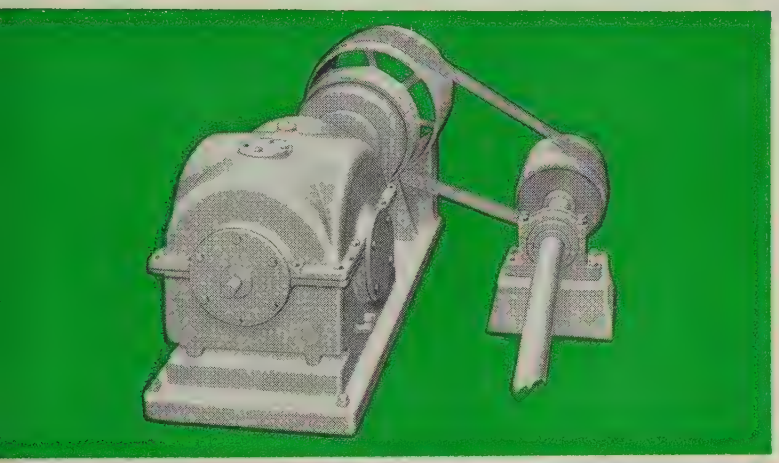
HYPOID

**PROVED BELOIT UNITS:** HELPER TYPE DRIVES · RUGGED BELOIT AIR CLUTCHES · SLACK TAKE-UP ARRANGEMENTS · INCHING DRIVES

ONE OF A SERIES SHOWING TYPICAL BELOIT SOLUTIONS TO COMMON MILL PROBLEMS

# Improve PRODUCTIVITY

A paper machine is no better than its drive. So a paper machine modernization program will almost always include some drive changes. Greater machine efficiency and productivity often can be obtained with only minor drive changes. Other situations may call for a completely new drive. Whatever the circumstances, Beloit drive units offer the rugged dependability that mills require in a paper machine drive. Beloit drive systems supply the required horsepower for given speed levels . . . provide accurate speed settings . . . maintain stability under varying load conditions . . . and hold precise draws. Drives shown below merit your careful consideration.



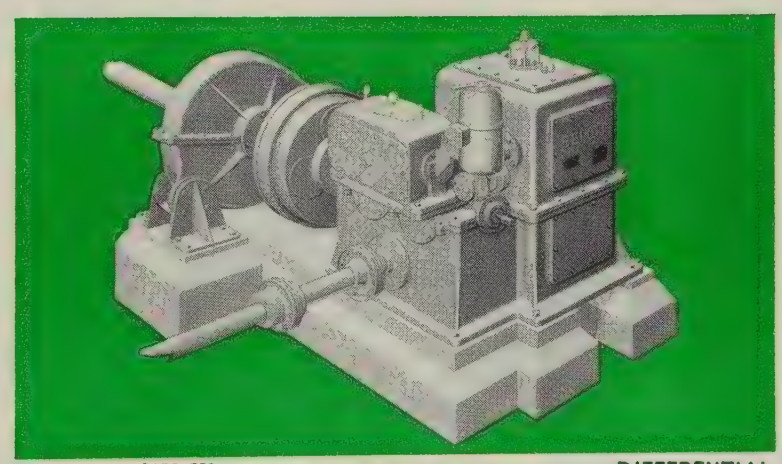
SHORT-CENTER PATENTED

### Need a floor-level drive?

If a floor-level type drive is in order, consider Beloit's short-center units. This drive arrangement keeps machine-room basement clear for auxiliary machine equipment or storage. Short-center arrangements are particularly adapted to machines with modest horsepower requirements where basement space limitations exist.

### High-speed draw problems?

Beloit differential drives provide an accuracy of draw many times better than previously available. A common lineshaft located at machine-room floor level ties all sections of the machine together mechanically. This drive is unequalled for application to wide high-speed machines or special-duty machines where the problem of maintaining draw between sections of differing mass is important. Many mills have chosen to apply differential-drive units to sections where the draw becomes a critical factor, thus gaining the advantages of Beloit's differential arrangement without the necessity of adding a complete machine drive.



PATENTED DIFFERENTIAL

**ACT!** *Take advantage of Beloit's experience in the design and building of mechanical drives, each built in the Beloit tradition of fine craftsmanship. Write to Beloit Iron Works, Beloit, Wis.*

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# Evaluate new PURECAL*O

**— Wyandotte's *refined* grade of pure calcium carbonate**

*Top-quality* coated stock — *at competitive prices* — will help you hold on to old customers . . . win new friends fast. That's why it pays to use Wyandotte's new calcium carbonate — *Purecal O!*

You see, *Purecal O* contains only 3% to 5% of loosely formed aggregates, averaging less than one micron in diameter. So compared with most other coating pigments, *Purecal O* is a more uniform, homogeneous product with greatly improved gloss and finishing characteristics.

The superior performance of *Purecal O* is the result of better particle packing and more uniform particle distribution. So papers coated with *Purecal O*-formulas consistently register *higher* on the Hunter Gloss scale, as compared with most common coating pigment formulas.

Why not investigate thoroughly the multiple benefits of *Purecal O* in your own formulation? For technical data and samples to evaluate in your laboratory, write: *Wyandotte Chemicals Corporation, Technical Inquiry Section, Wyandotte, Michigan. Offices in principal cities.*

**SIZED FOR MAXIMUM HIDING POWER**

At 0.25 micron, particles of *Purecal O* have maximum hiding power; provide *extra* gloss and sheen without sacrificing opacity.

**SPECIALLY PRECIPITATED FOR PURITY**

Precipitated *Purecal O* contains no impurities to cause "off-whiteness" or muddy colors; no grit to wear printing plates prematurely.

*REG. U.S. PAT. OFF.

***Other Wyandotte products for the paper industry:***

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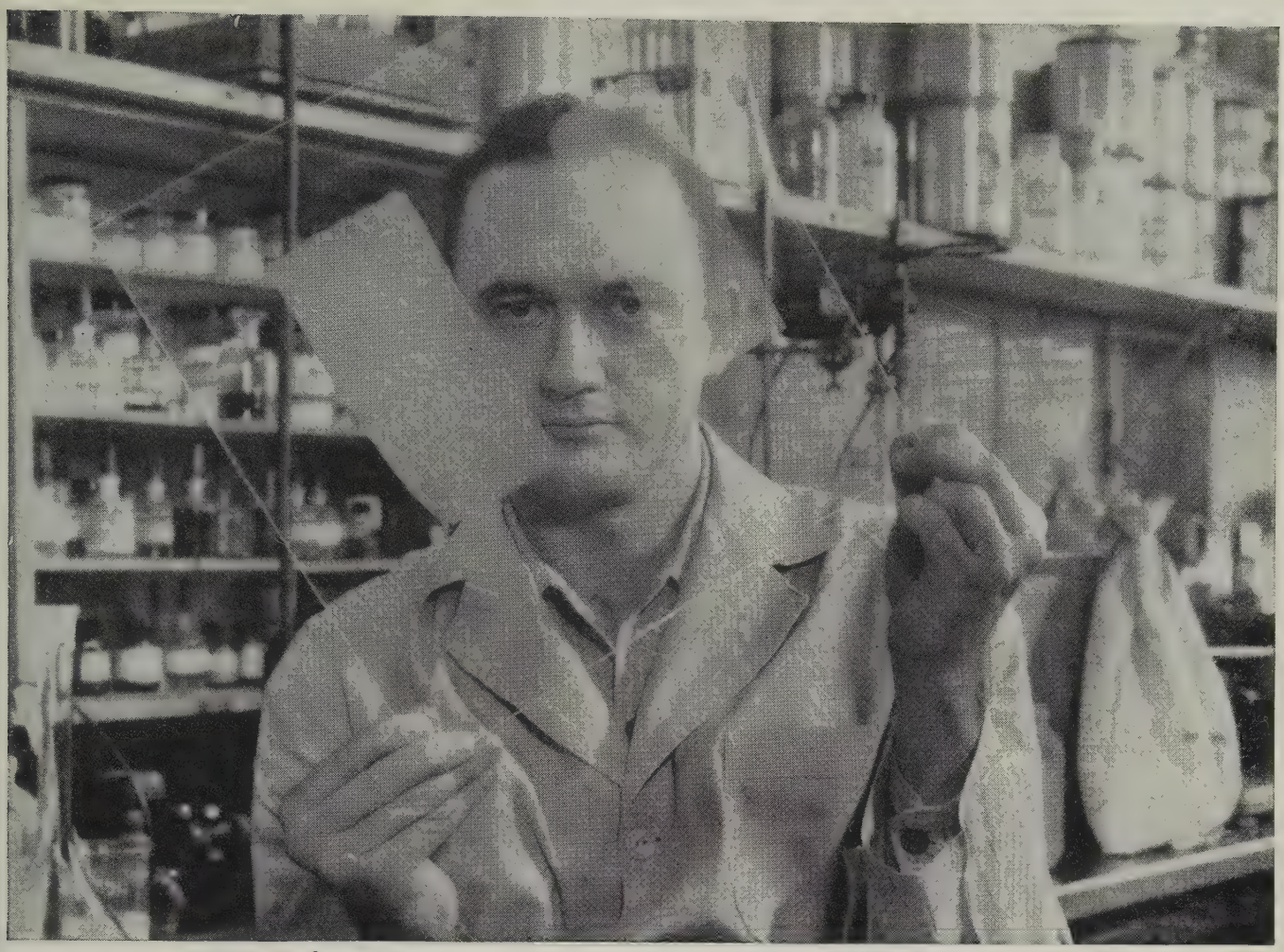
*MICHIGAN ALKALI DIVISION*

PACING PROGRESS WITH CREATIVE CHEMISTRY



Smears of size on glass show clarity of Ten-O-Film, right, almost invisible, compared with conventional starch, left.

# Sure way to CLEAR, UNIFORM COATING

The highest degree of coating quality can be achieved with the new, improved Ten-O-Film starches.

These new starches possess unexcelled clarity, uniformity and film-forming properties. They are available in a series of fluidities to meet your exact requirements. Because of their high degree of viscosity stability at high solids, Ten-O-Film starches reduce setback and maintain adhesive strength, assure good performance. At lower concentrations Ten-O-Film starches assure superb structural film continuity and excellent results.

For technical assistance in selecting the TEN-O-FILM starch best suited to your needs contact our nearest sales office or write direct.

## TEN-O-FILM® starches

*Fine products for the Paper Industry: EAGLE® • FOXHEAD® • GLOBE® • TEN-O-FILM® and CLARO® starches. GLOBE® dextrines and gums.*

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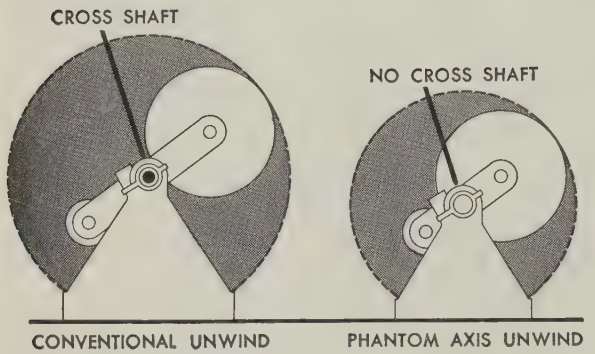
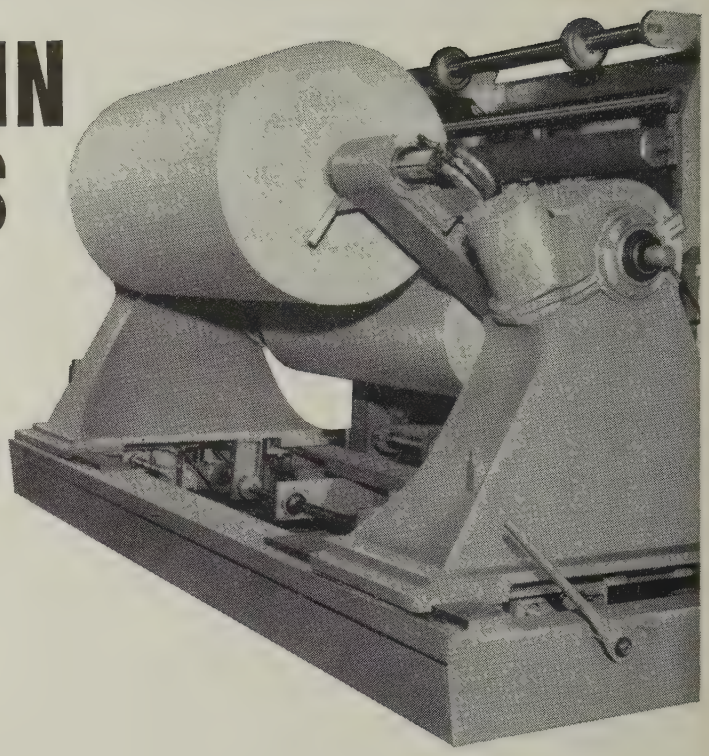
# ANNOUNCING... A NEW ADVANCE IN TURRET UNWINDS

## EGAN PHANTOM AXIS* TURRET UNWINDS



***ELIMINATION OF CENTER CROSS SHAFT MAKES THE DIFFERENCE— GREATER ROLL DIAMETERS, MORE COMPACT DESIGN, FAR LESS HEIGHT AND FLOOR SPACE**

## FEATURES

Pneumatic constant tension system (optional)

Compact design means more rigidity; better operation at high speeds

Speeds in excess of 1000 fpm

Flying splices at full machine speed

Provision for splicing with either inside or outside of web up (optional)

Knife cut-off

Power rotation of turret

Automatic or manual side shifting

Air chucking of cores or shafts (optional)

Web widths through 120″

Write, or phone Randolph 2-0200, for illustrated technical data giving complete information on the new Phantom Axis Turret Unwind Series, and its companion unit, The Egan Phantom Axis Turret Winder.

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CABLE ADDRESS: EGANCO—SOMERVILLE (NJER)

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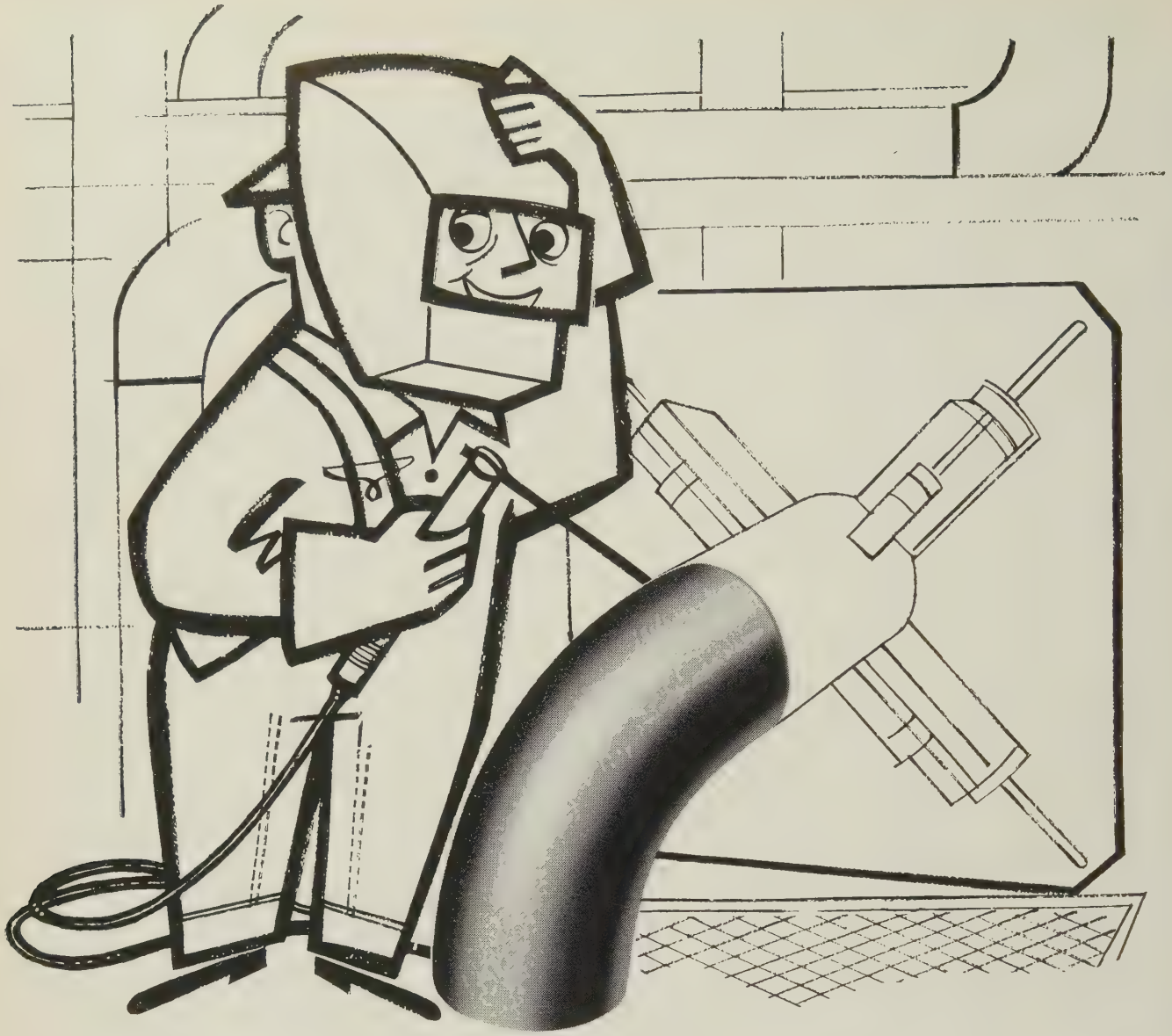
*With a bow to Lewis Carroll's "Alice in Wo



# B&W JOB-MATCHED WELDING FITTINGS

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Dimensional accuracy is the key to economical pre-fabrication and installation of process piping . . . and you get true accuracy with B&W Job-Matched Welding Fittings. This means:

- during fabrication sections can be pre-cut and you know they will fit
- welding time is reduced because there are fewer fit-up problems, eliminating time consuming and costly fill-in welding
- fabricated sections can be installed without delays because each fitting is well within tolerance.

Ask for B&W Job-Matched Welding Fittings through local B&W District Sales Office or any qualified welding fittings distributor, or write for B&W Bulletin FB-504, The Babcock & Wilcox Company, Tubular Products Division, Fittings Department, 3839 West Burnham Street, Milwaukee 46, Wisconsin.

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# Sprout-Waldron offers you this free technical literature

### REFINERS (96-B) (185)

The precision-built 36-2 "Sprout" (96-B) is the most efficient disc type refiner in quantity of output and in quality of refined pulp per hp. input; available from 400 to 800 hp. The 36-1 S-W Refiner (185) is completely versatile in a wide range of applications; capacities from 75 to 300 hp.

### REFINERS, PILOT PLANT (184)

Precision-built for accurate results which can be reliably translated into production figures, and for continuous operation in small commercial plants.

### REFINERS, LABORATORY (17-A)

Used for pulping and strength development studies; reproduces end results similar to those obtained from larger refiners.

### CONTINUOUS DIGESTER (196)

Creatively engineered system for producing uniform pulp economically. Really two units in one, this S-W Digester is a completely new concept in continuous pulping.

### FLAT BED DRAINER (186)

Used for removing free liquor from chips, rejects, and other high freeness materials.

### UNIFLOW FEEDER (187)

Developed specifically to meter and maintain a constant feeding rate to the refiner.

### LABORATORY MIXER (188)

For research studies involving bleaching, mixing of coating formulas, starch cooking, cold caustic chemical pulping, and others.

### FIBERPRESS (190)

Sprout-Waldron/Anderson unit removes large percentage of black liquor and dissolved solids.

### STOCK PROPORTIONER (191)

Sprout-Waldron/Cowan unit provides accurate volumetric metering and proportioning of pulps to the paper machine chest.

### ROTARY FEEDER VALVE (197)

Assures positive, accurate feeding into pressure vessels; minimizes steam loss; eliminates steam blow-back; reduces hp. requirements.

### PULP PELLETING (F-962-A) (F-1042)

These two process flow sheets explain the recently developed Sprout-Waldron pulp pelleting process (F-962-A) and the high density storage system. (F-1042)

### CONDENSED CATALOG (183)

A condensed catalog of Sprout-Waldron equipment for the Pulp and Paper industry, including equipment for conveying, mixing and blending, size reduction and classification, pelleting, bulk materials handling.

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SP/110

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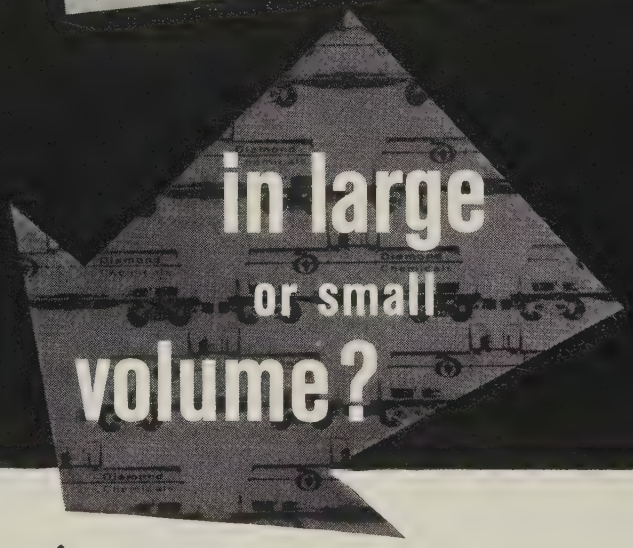

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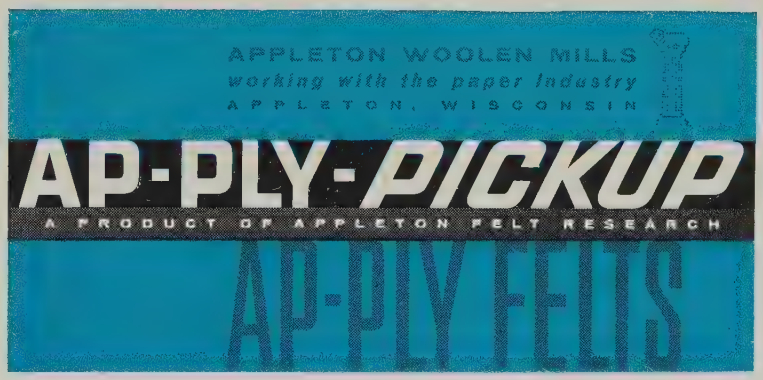
*Ask your*

*Appleton man.*

*He has the answer.*

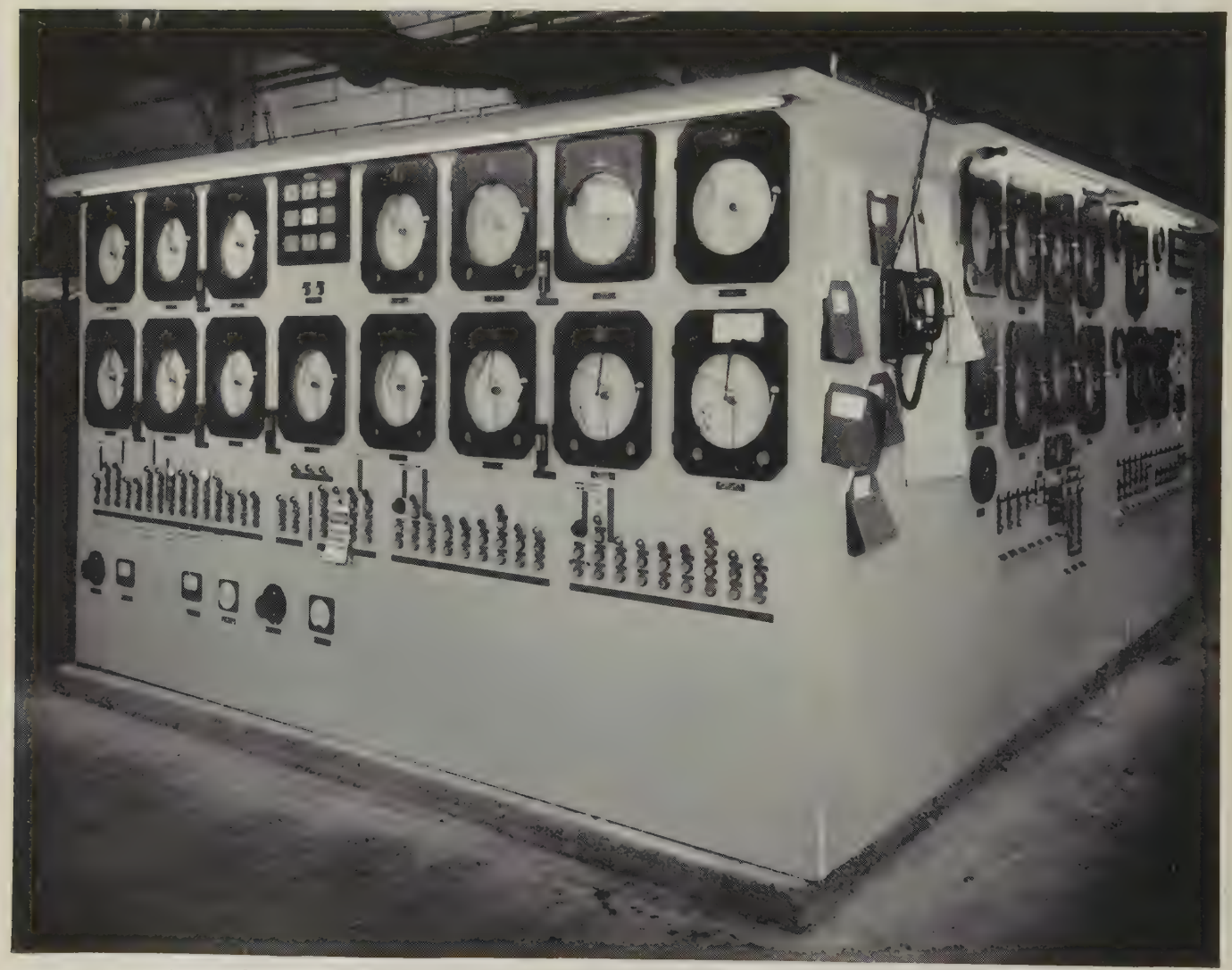



**APPLETON WOOLEN MILLS**

***WORKING WITH THE PAPER INDUSTRY***

APPLETON, WISCONSIN

# Finch, Pruyn produces higher quality paper at lower operating costs



*Unique, L-shaped Taylor instrument panel has Refining, Screening and Brown Stock Washing controls on left. Digester Process control on right.*

Taylor Instruments

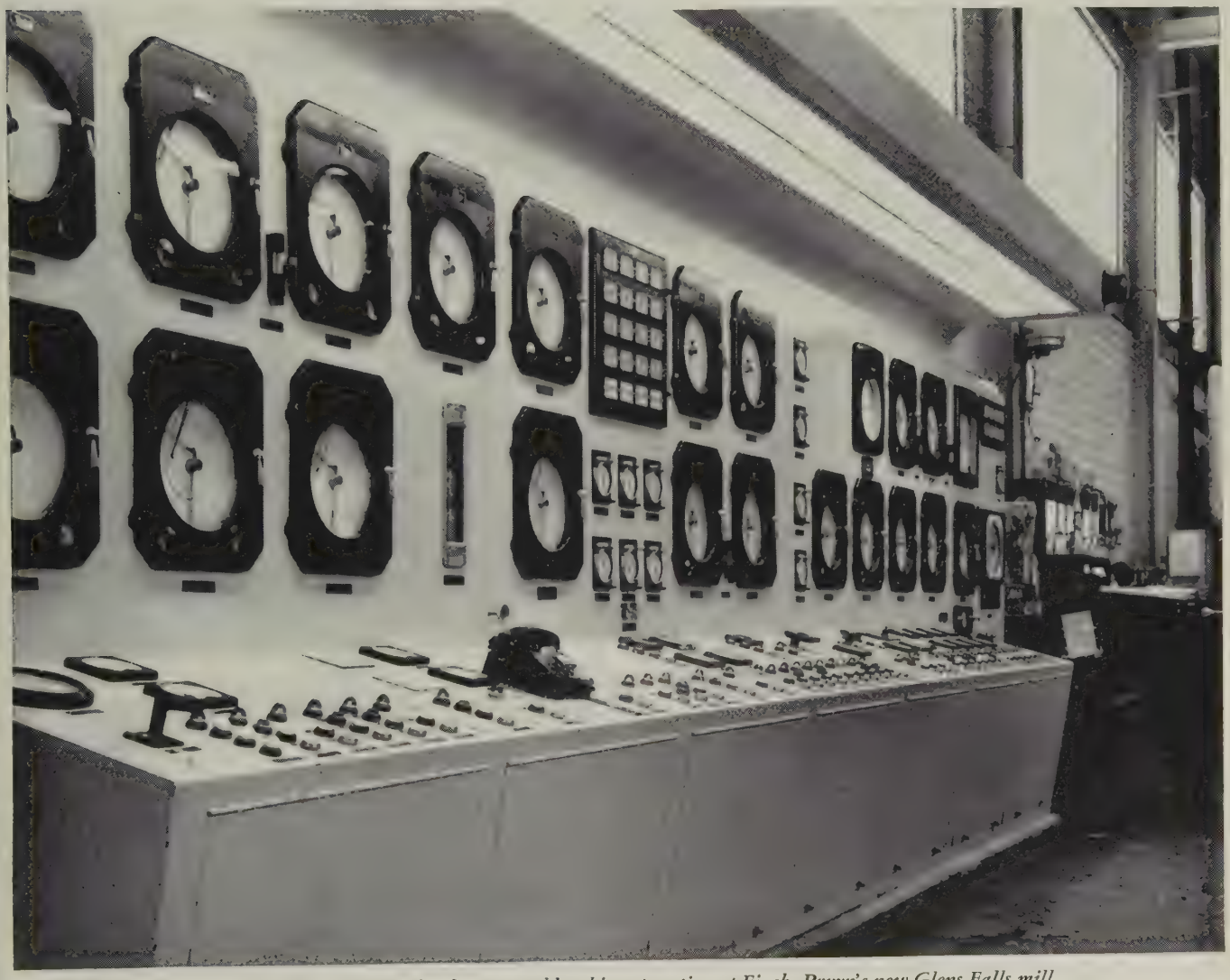
# Taylor Automatic Control Pays Off!

A higher quality paper at lower operating costs was the goal of Finch, Pruyn & Co., Inc., when they built their new neutral sulphite pulp mill at Glens Falls, N. Y. Designed to manufacture hardwood pulp for use in the production of high strength, high brightness and economically priced printing and converting papers, the new mill utilizes automatic controls at every possible stage. As a result of previous experience, Finch, Pruyn chose Taylor instrumentation throughout the mill. So well instrumented is this new mill that it requires only a foreman and three operating personnel for each shift. The instrument man and pulp mill superintendent are present on the day shift only.

Designed and engineered by Chas. T. Main, Inc., the new mill produces between 70 and 100 tons of hardwood pulp per day. It is expected that the output will eventually reach 140-150 tons daily.

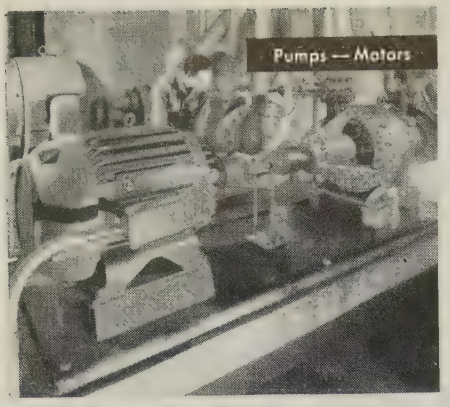
Here's another example of a complete pulp mill under Taylor control . . . and of a very satisfied Taylor customer.

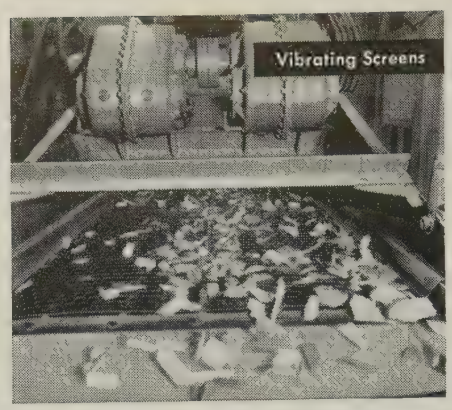
If you're thinking of modernizing existing plant, or of building a new one, it will pay to call in your Taylor Field Engineer in the early planning stages. Or write Taylor Instrument Companies, Rochester, N. Y., or Toronto, Ontario.

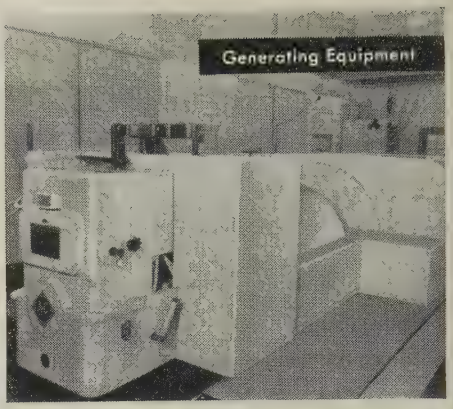


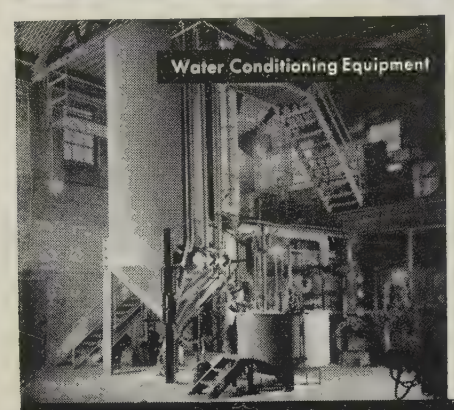
*Taylor control panel for the three stage bleaching operation at Finch, Pruyn's new Glens Falls mill.*

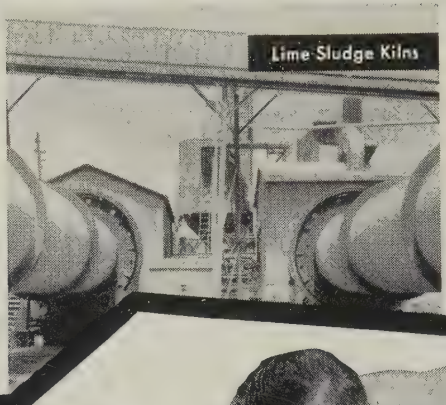
**MEAN ACCURACY FIRST**

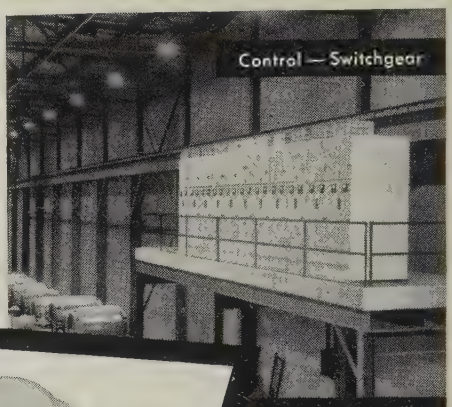


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## your Allis-Chalmers man... can supply and coordinate all this equipment — and more

Pumps, motors, drives, processing machinery, electrical equipment, water conditioning equipment, materials handling equipment — Allis-Chalmers builds them all. Much of it is specifically designed for pulp and paper service. All of it is designed to work together. And you get more, much more, than the finest equipment when you specify Allis-Chalmers. The obvious time- and money-saving advantages of single-source buying, and a host of services ranging from preliminary planning to continuous field service, are all yours.

Whether you are contemplating major modernization or the profitable addition of a single machine, the man to call is your A-C representative. His recommendations are backed by the many Allis-Chalmers engineering departments, by complete research and testing facilities, by experience gained in a close working relationship with the pulp and paper industry. *For complete information, contact your nearby A-C sales office or write Allis-Chalmers, Milwaukee 1, Wisconsin.*

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Precision grinding and the most modern vulcanizing facilities insure uniform, exact density and accuracy of roll crown dimensions within .002". And Manhattan was first to dynamically balance rolls electronically at customer's machine speeds . . . to assure *even* pressure and moisture distribution in the stock, less wear on felts, bearings and journals —You get top production speeds on your equipment at lower dryer-steam costs!

Let a Manhattan specialist show you how you can get better, longer roll service . . . "More Use per Dollar" . . . with Manhattan Press and Suction Press Rolls, Rub-Roc, Sham-Roc, Self-Skinner and Coating Rolls, Sealed-End Couch Rolls and Marblex Table Rolls.

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What can match the thrill of the first run on a new paper-making machine? *Only 90 minutes after the first start-up, press-ready paper was produced at Southland Paper Mills, Lufkin, Texas* on a new Pusey and Jones Fourdrinier machine.

This new machine was a huge, 270-inch wire-width Fourdrinier, the third complete paper-making machine designed, built and installed by Pusey and Jones for Southland. It typifies Pusey and Jones' ability to provide on-time start-ups for paper mills the world around.

***Top photograph:*** *Wire of new Southland machine being moved into operating position as it rests on the power-operated undercarriage of Pusey and Jones' Rapi-Drape Wire Changing Device.*

***Bottom photograph:*** *Overall view of new Southland Paper Mills machine.*

**Data on Southland's New Fourdrinier Machine:**

***Wire Width, length and speed:*** *270" wide x 118' long. Speed: 2500 f.p.m.*

***Number of presses:*** *Two 42" diameter main suction press rolls, complete with vacuum pickup.*

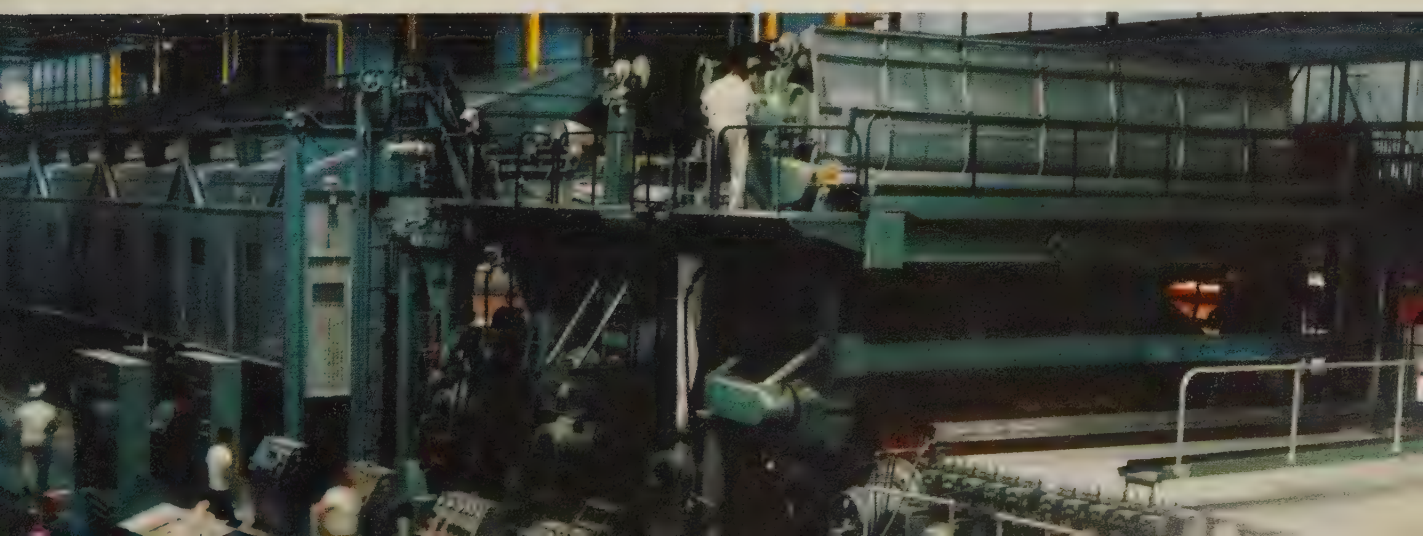
***Dryers:*** *53 main paper dryers; one sweat dryer; 8 felt dryers; 60" diameter x 268" face.*

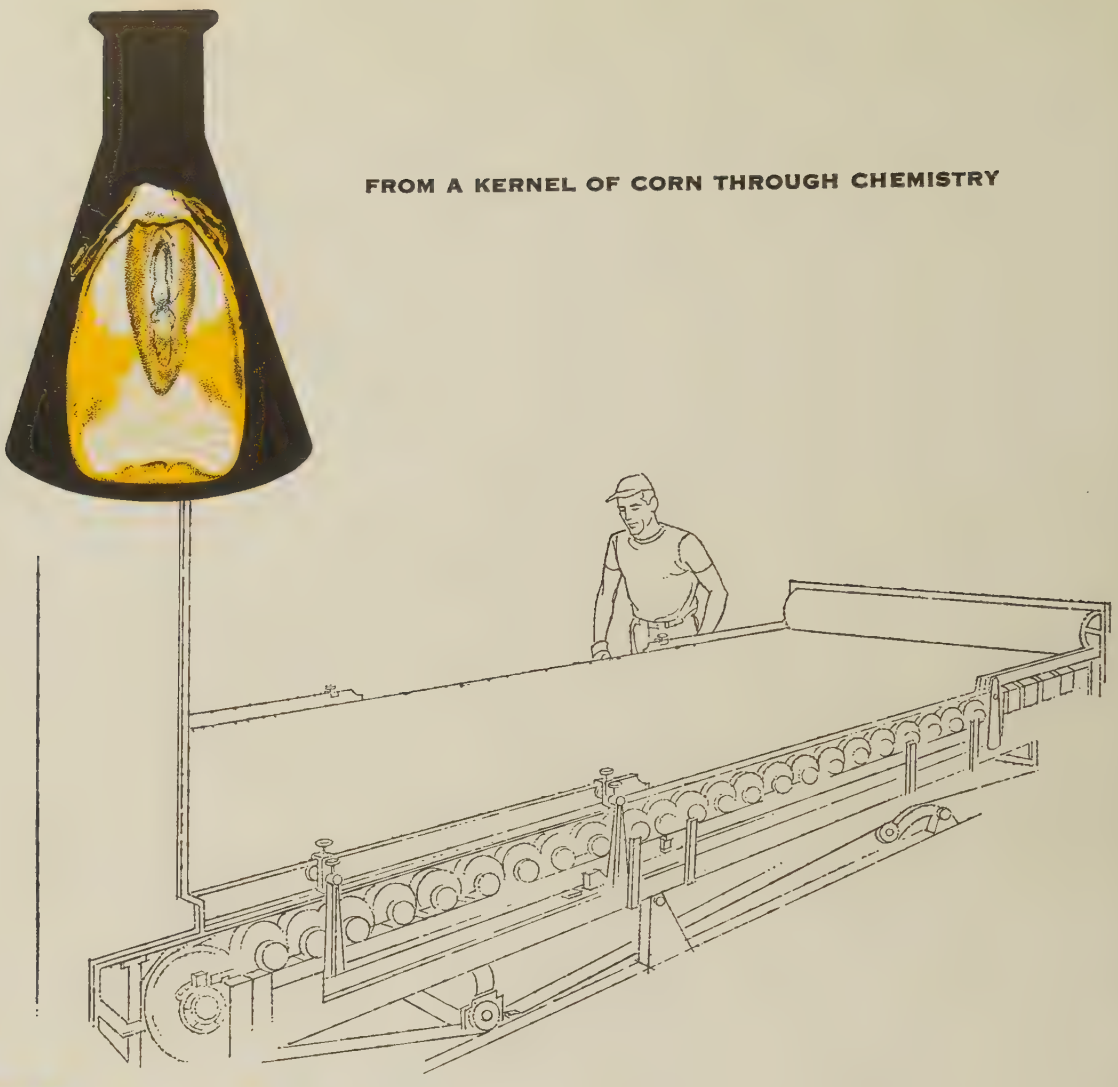
***Calendar stacks:*** *One, 8-roll with 40" diameter bottom roll, 26" diameter next-to-bottom roll, and six 18" diameter intermediate and top rolls.*

***Reel:*** *Latest horizontal, uniform-speed type.*

**THE PUSEY AND JONES CORPORATION**

WILMINGTON 99, DELAWARE





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CATIONIC WET END ADDITIVE

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CATO is another unique starch derivative from National. Its molecule carries cationic groups. These are attracted by relatively anionic cellulose fibers. The result is extraordinary strength in papermaking. Also, it significantly increases retention of pigments, fillers and other additives. And it is one of the most effective means known for producing higher ash content sheets without loss in physical properties.

CATO leads to unusual improvements. At one mill, with higher mullen and faster machine speeds. At another, with increased strength and a less costly pulp mixture. At another, with increased pick, fold and mullen and lower starch costs. To name a few.

CATO is highly effective with sulfite, soda and groundwood pulp. Also with kraft and reclaimed stocks. Additions are small because it is virtually 100% retained in the sheet. For full information, contact your nearest National office.

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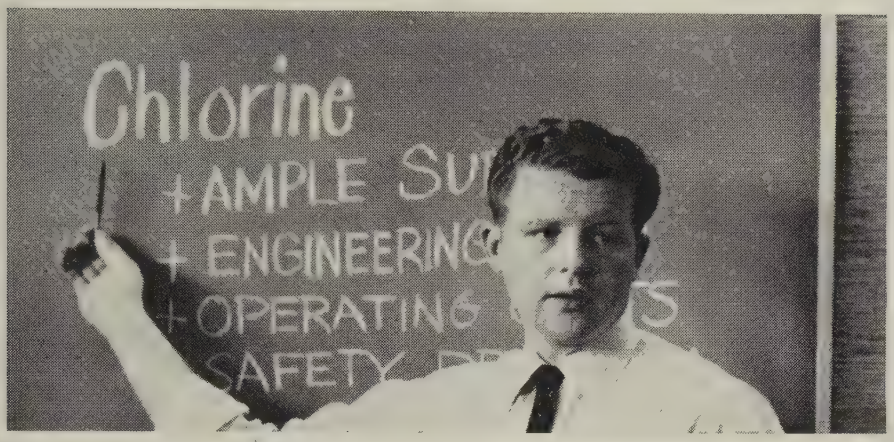
# BRIEFS

**on 4 chlorine "pluses" . . . a caustic soda guide . . . 3 built-in sodium sulfide controls . . . an important sulfide drum**




## You get these 4 pluses when you ask for *Hooker* chlorine

**1. Engineering help.** You can get aid from Hooker engineers in planning or revamping your chlorine handling system.

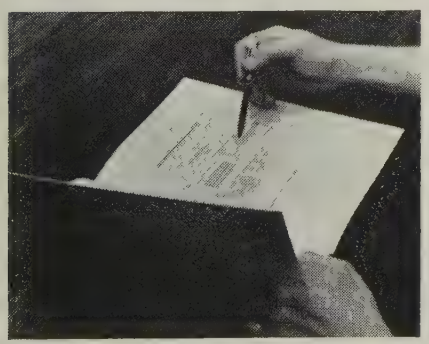
**2. Operating hints.** Our technical service men can often spot—and help you fix—troubles before they become serious. You get periodic technical service visits.

**3. Safety programs.** We keep you up to date on the safest and most economical handling methods.

**4. Ample supply** from Hooker plants which bridge the continent: Niagara Falls, Montague, Mich., Tacoma, and North Vancouver. And, of course, you get a chlorine that meets high industry standards when you ask for Hooker.

Send the coupon for our Chlorine Manual, 76 pages of useful facts on chlorine, its handling and usage.

Phone or write the nearest Hooker sales office for further information on how we can help you.



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Check the coupon for specifications.

**For more information** on chemicals mentioned on this page, check here:

☐ Hooker Chlorine Manual ☐ Sodium Sulfide Data Sheet

☐ Hooker Caustic Soda Guide ☐ Sodium Sulfhydrate Data Sheet

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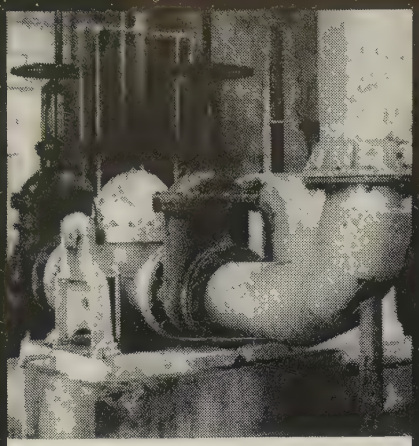
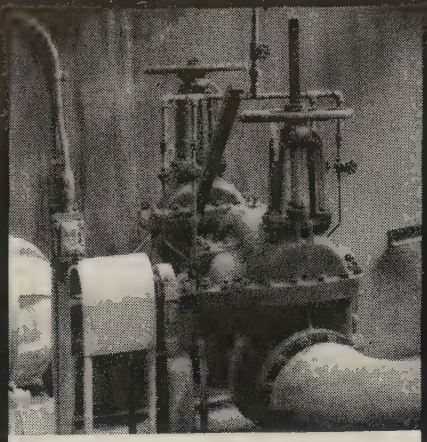
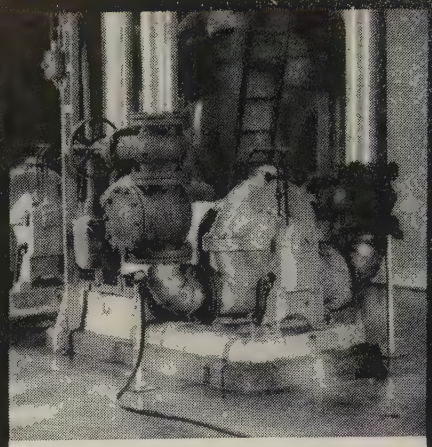


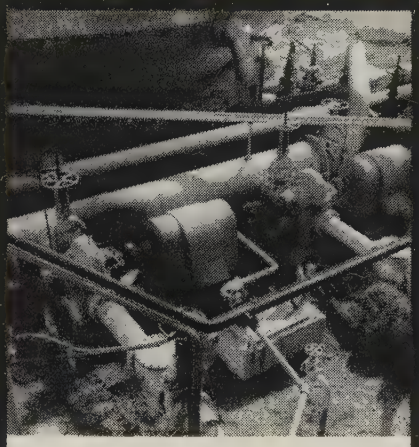
**GOULDS FIG. 3405,** double-suction centrifugal handling 4,000 GPM white water against 100 ft. head to screen showers.



**GOULDS FIG. 3405,** double-suction centrifugal pump handling 2,000 GPM strong black liquor from foam tank to storage.



**TWO GOULDS FIG. 3405,** double-suction centrifugals at left are rated for 800 GPM against 240 ft. head for fresh water shower and for squirt and trim knock-off service.



**GOULDS FIG. 3450,** double-suction centrifugals on mill water supply. All are rated for 9,000 GPM against 100 ft. head.

## See how this mill uses Goulds pumps to solve *every* pumping problem

At this large pulp and paper mill* in the south, Goulds pumps are performing every kind of pumping job: mill water, liquors, white water, stock up to 4½% and others.

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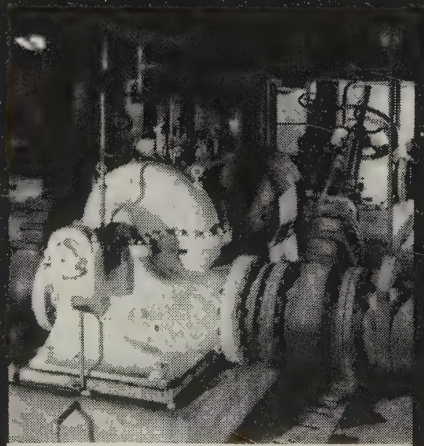
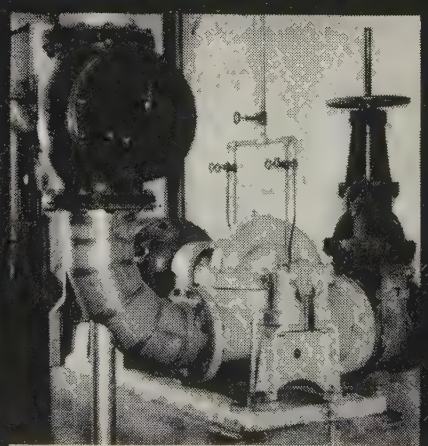
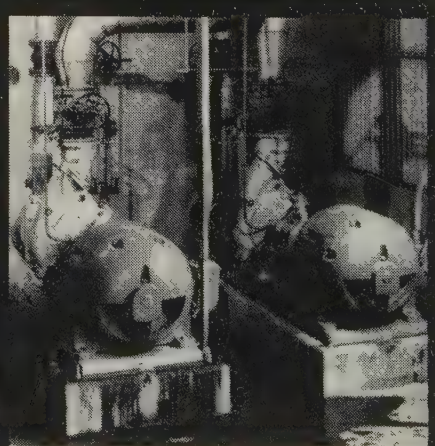


**GOULDS FIG. 3450,** double-suction centrifugal pump handling 7,000 GPM weak bleach liquor to washer. In background are three Goulds liquor pumps.



**GOULDS FIG. 3405,** double-suction centrifugals pumping white water. Pump illustrated is pumping 4,000 GPM to line type consist regulators.



**TWO GOULDS FIG. 3105,** stock pumps handling 585 gallons per minute of one per cent stock from centri-cleaners.

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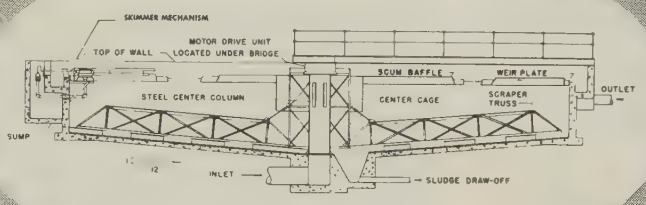


**If you require only settleable solids removal** you'll do well to consider an INFILCO clarifier for simple gravity settling. Correct hydraulic and mechanical design insures satisfactory performance and minimum maintenance expense.

The WS Clarifier mechanism with a central drive shaft supported from stationary beams spanning the tank is available for small and medium diameter units. The BF mechanism with the scraper assembly suspended from a turn-table carried by a central column is preferred for larger size clarifiers.

Surface skimmers are available for floatable solids.

For complete information, send for

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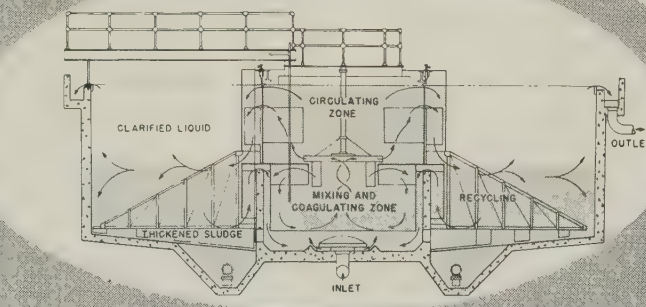


**If pollution control regulations** or your plans for water recovery require colloidal as well as settleable solids removal by chemical coagulation, specify the CYCLATOR® clarifier to obtain unique design features which give you maximum clarification.

Untreated waste and chemicals are mixed in the presence of previously precipitated solids which are recirculated from the settling zone. This promotes formation of large dense floc particles which settle rapidly and produce maximum clarification.

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**Bulletin 850-C**

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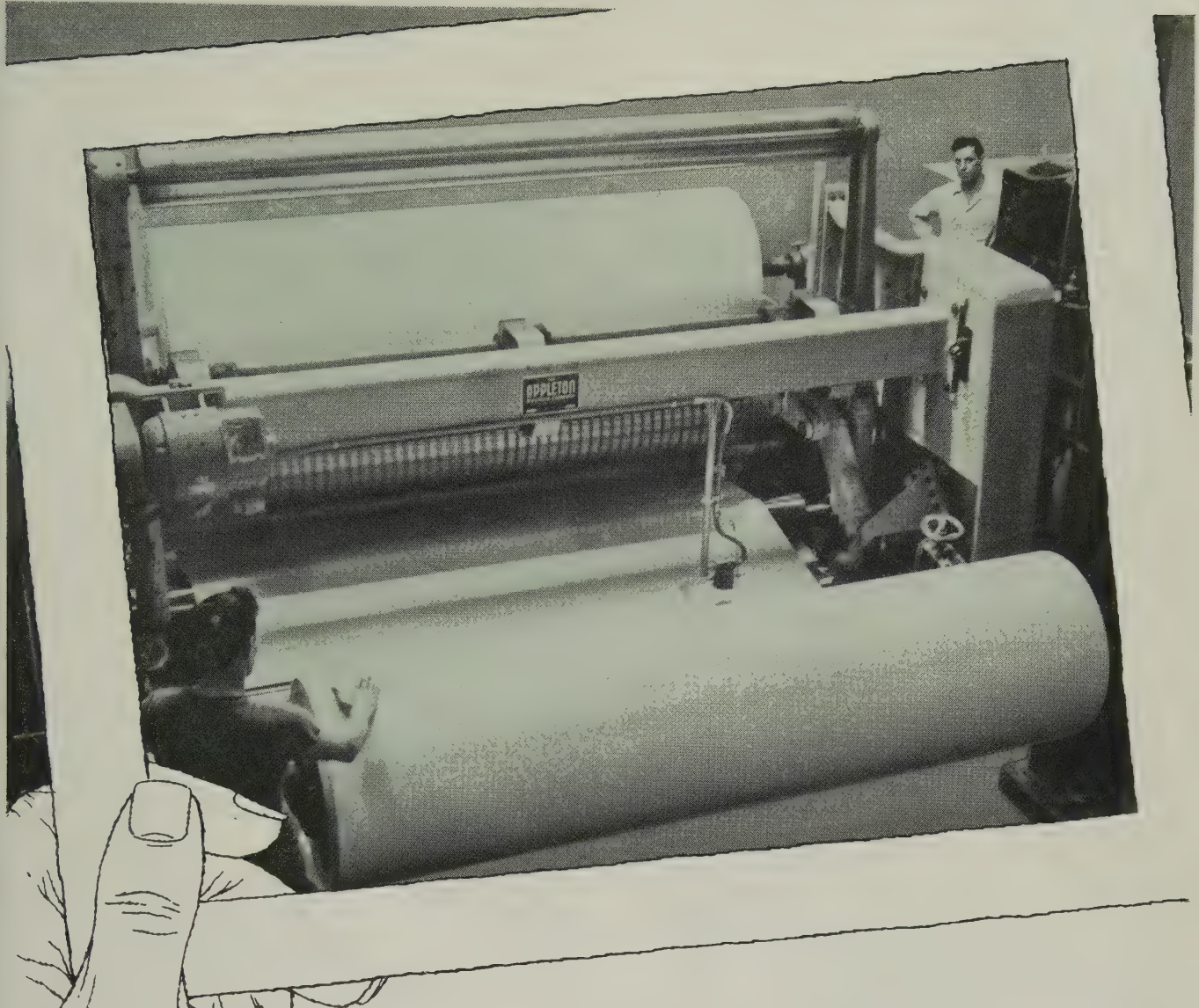


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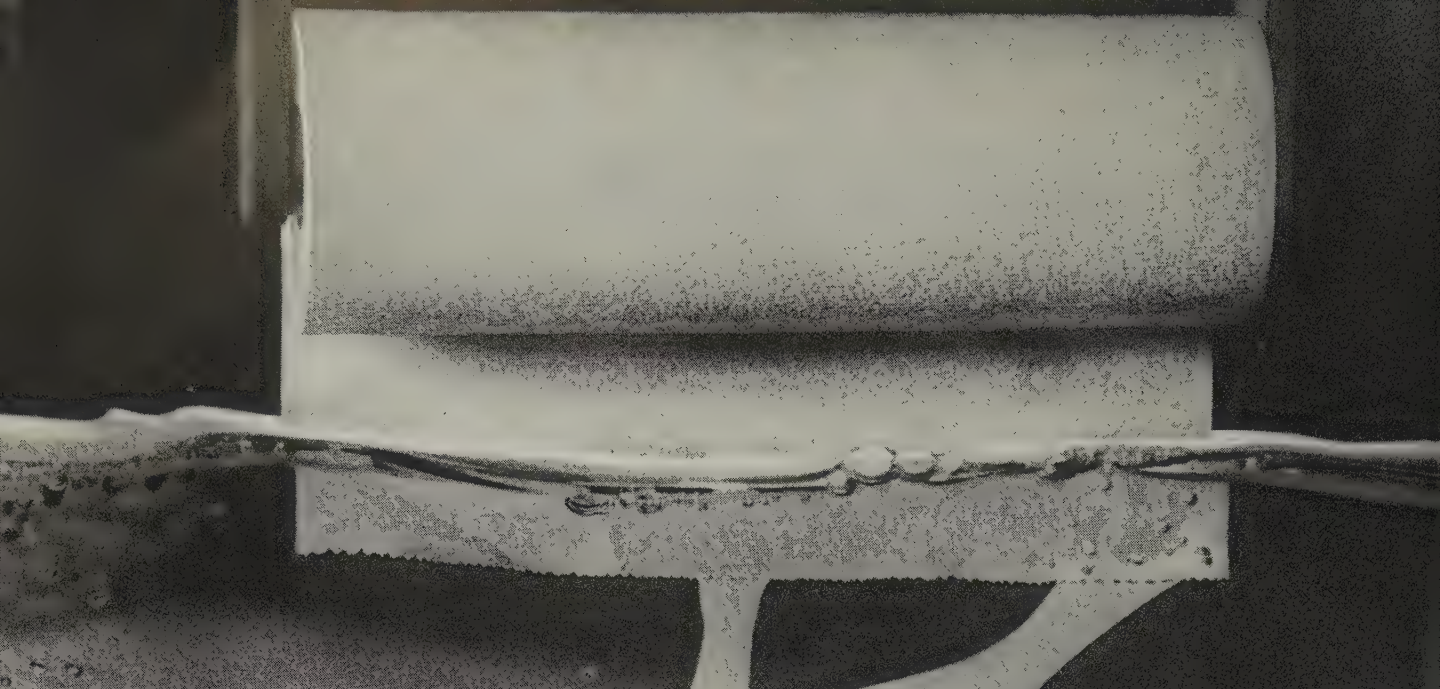

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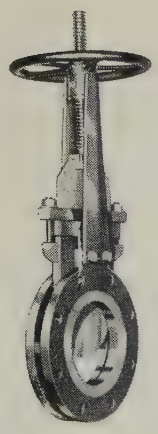

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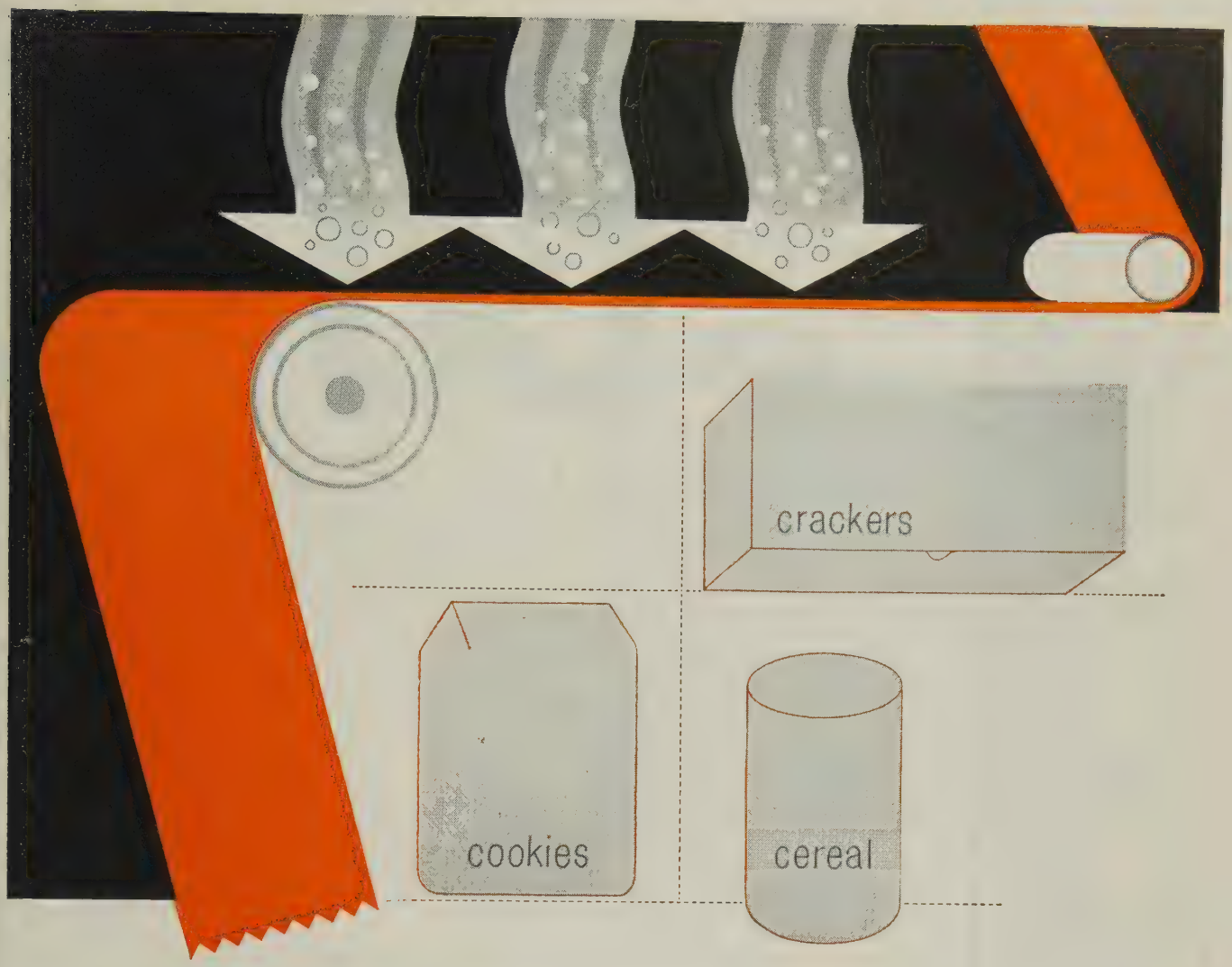


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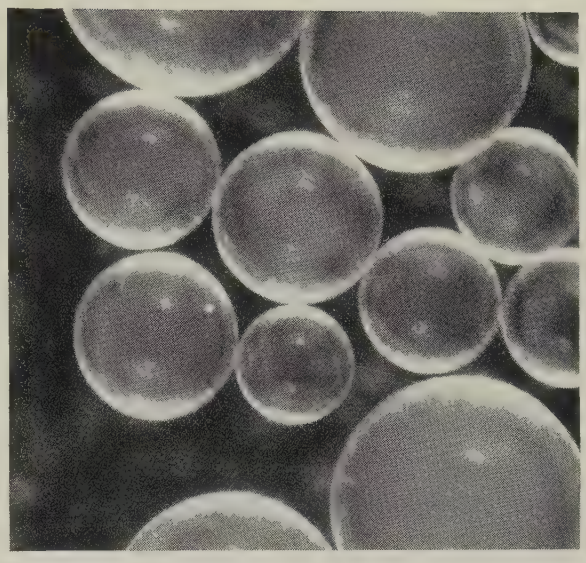

**Nalcite HCR-W under the photomicroscope looks like no other ion exchange resin: clear, perfectly-formed microspheres, stress-free, crack-free, virtually breakage proof in any known ion exchanger service.**

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*TITANOX is a registered trademark for the full line of titanium pigments offered by Titanium Pigment Corporation.

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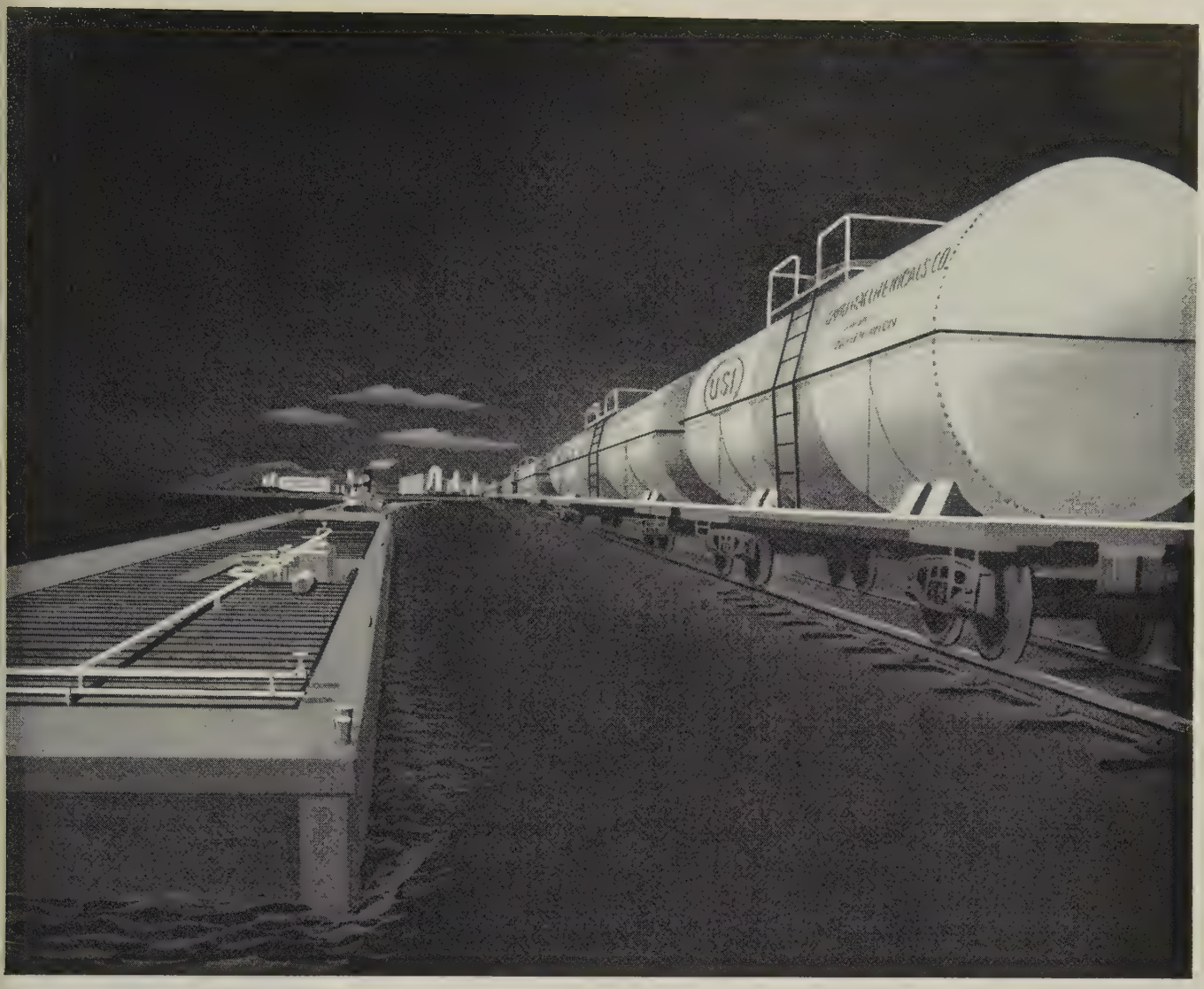


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- You'll be working with a 50-year old chemical manufacturing company with a reputation of service to its customers throughout that half century.
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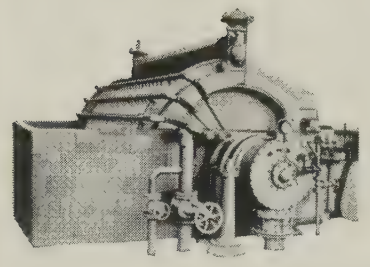
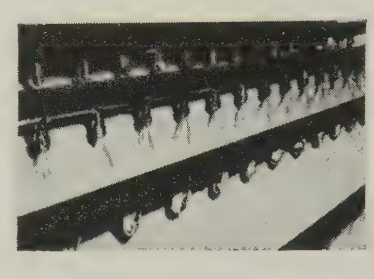
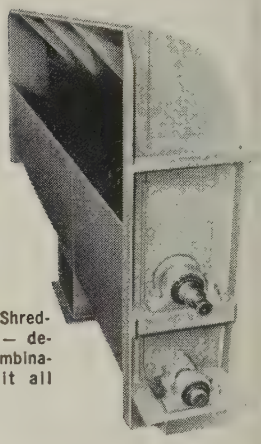


Oliver Vacuum Bleach Washer — now available in advanced designs and materials.



Dorr-Oliver Escoe and Nycoe Nozzles — minimize channeling and foam in the sheet.



Dorr-Oliver Shredder-Conveyor — designs and combinations to suit all installations.

## AGITATORS

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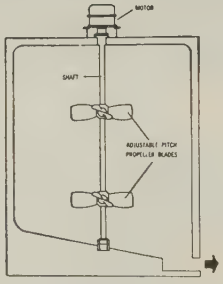
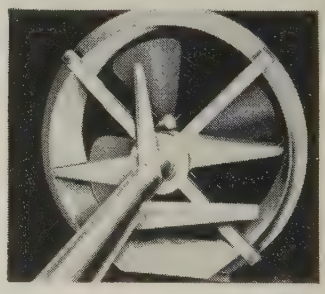
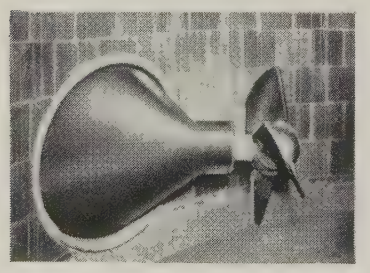


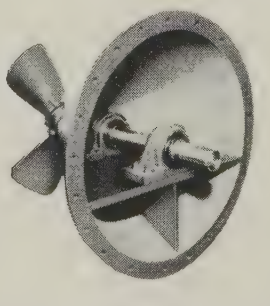

Dorr-Oliver Blending Chest Agitators — designed for proper agitation with minimum power requirements.



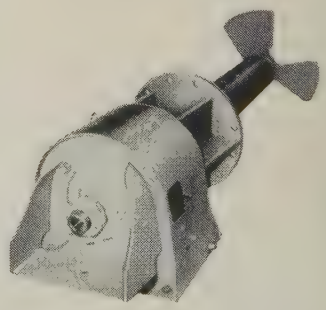
Dorr-Oliver Horizontal Chest Agitators — a complete line designed for tub or mid-feather type chests.



Dorr-Oliver Bleach Tower Agitators — tangentially mounted with either fixed or fully adjustable blades.



Dorr-Oliver Tower Agitators — for high density storage towers. Adjustable propellers.

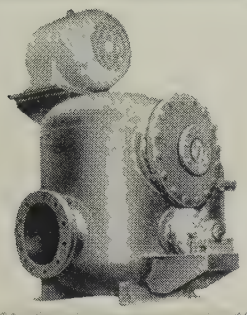


Falk All-Motor Driven Agitator — single unit motor, reducer and propeller assembly.

# BLEACH PLANT EQUIPMENT

*pulp mill engineers for pulp mill service*

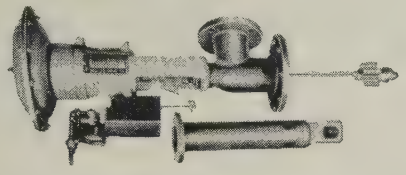
## MIXERS



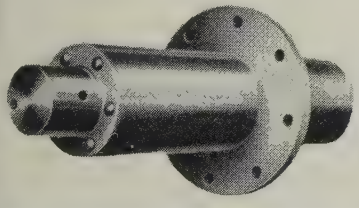
Dorr-Oliver Chlorine Mixer—rubber lined pressure chamber with internal counter-rotating propellers.

Dorr-Oliver Double Shaft Heater Mixer — rotating assemblies feature alternate propelling vanes and agitating pins. Reinforced stainless steel shell. Bearings outside shell for better protection.

## NOZZLES



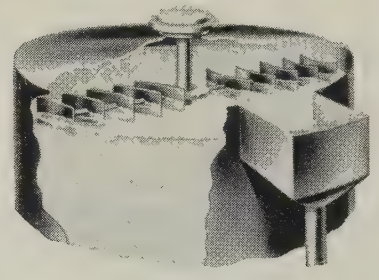
Dorr-Oliver Tower Dilution Nozzles — diaphragm actuated design features uniform, chatter-free throttling with freedom from plugging.

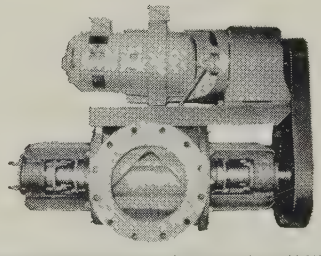


Dorr-Oliver High Density Storage Tower Nozzles — unique design with rotary oscillating action insures minimum wear and leakage.

## MISCELLANEOUS BLEACH EQUIPMENT

Dorr-Oliver Top Scraper — rubber covered demountable rake arm provides continuous movement of stock towards launder. Adaptable for low density upflow bleach or chlorination towers.





Dorr-Oliver Rotary Vaned Feeder — for metering pulp or cooked chips in or out of pressure zone. Design minimizes shock loadings.

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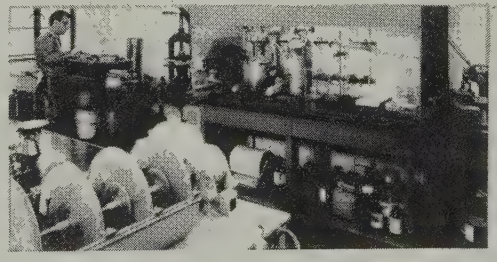

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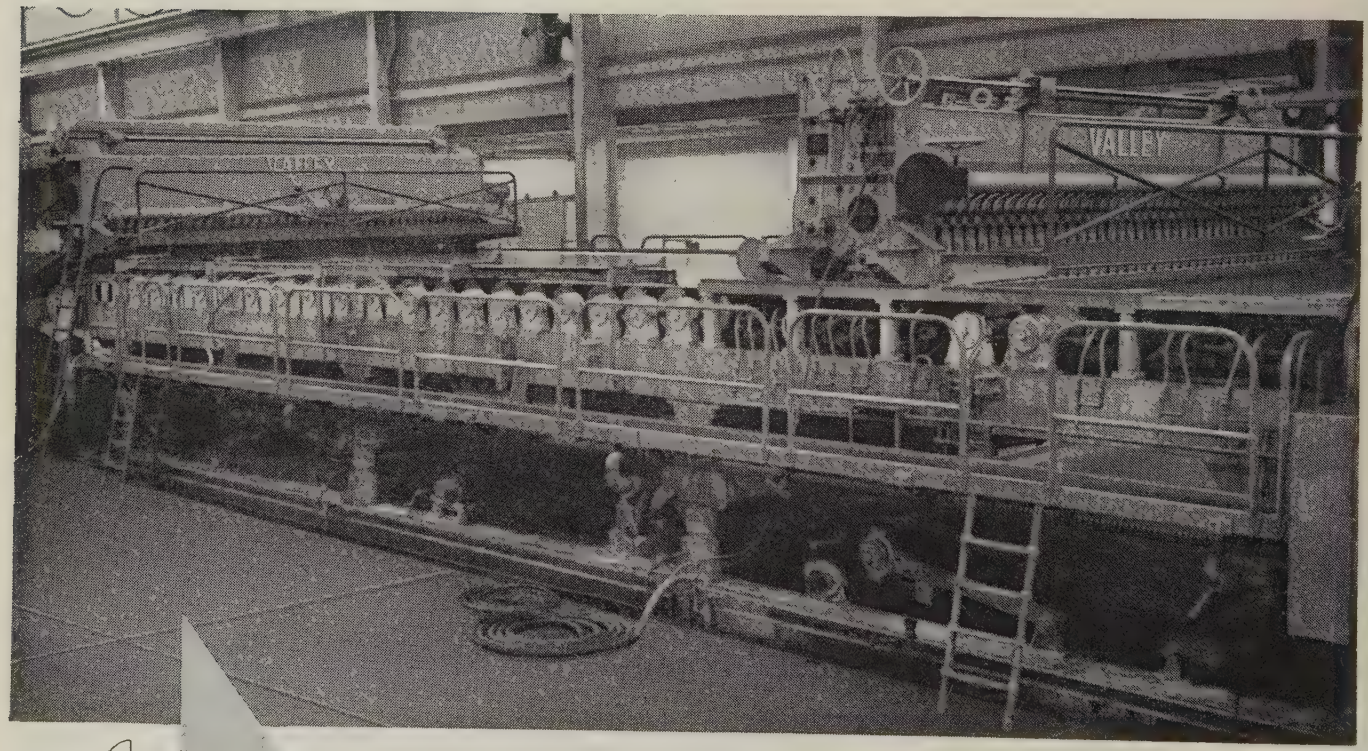


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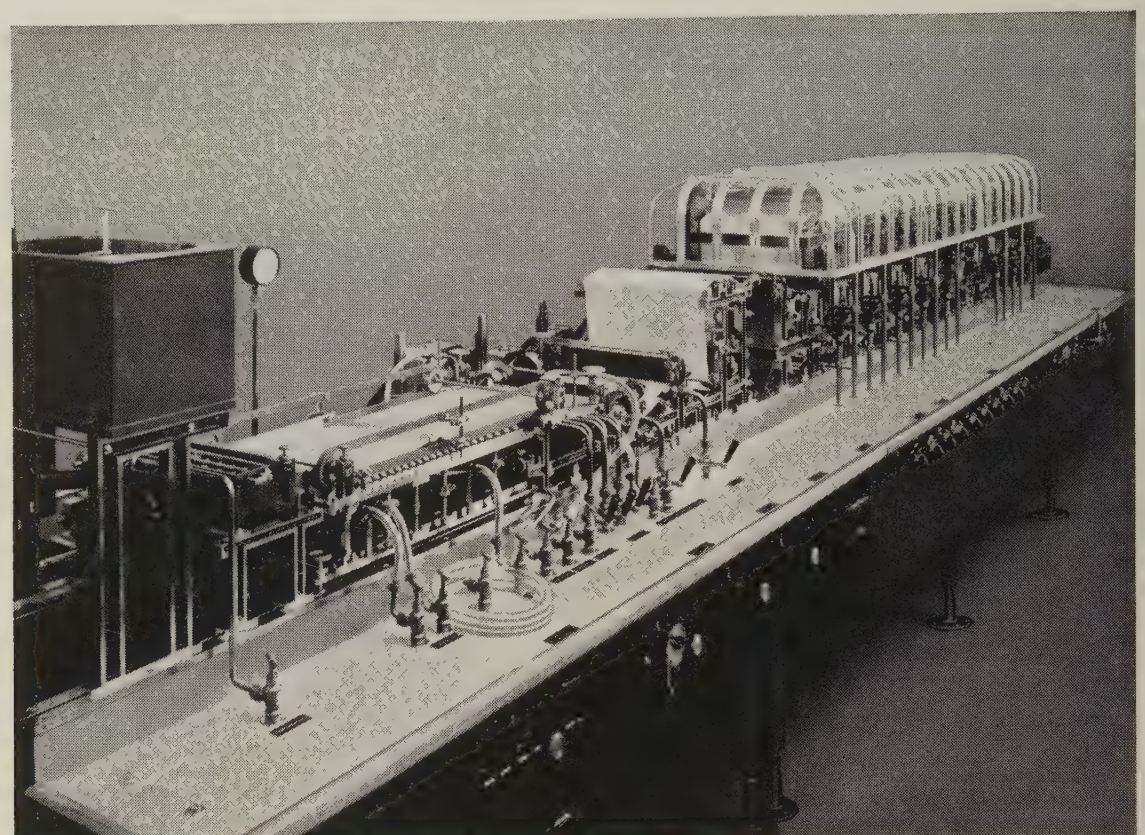

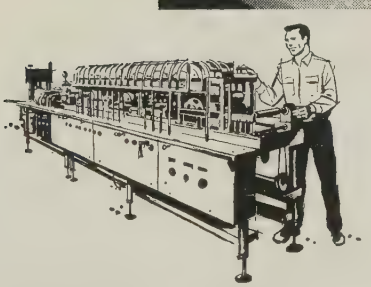

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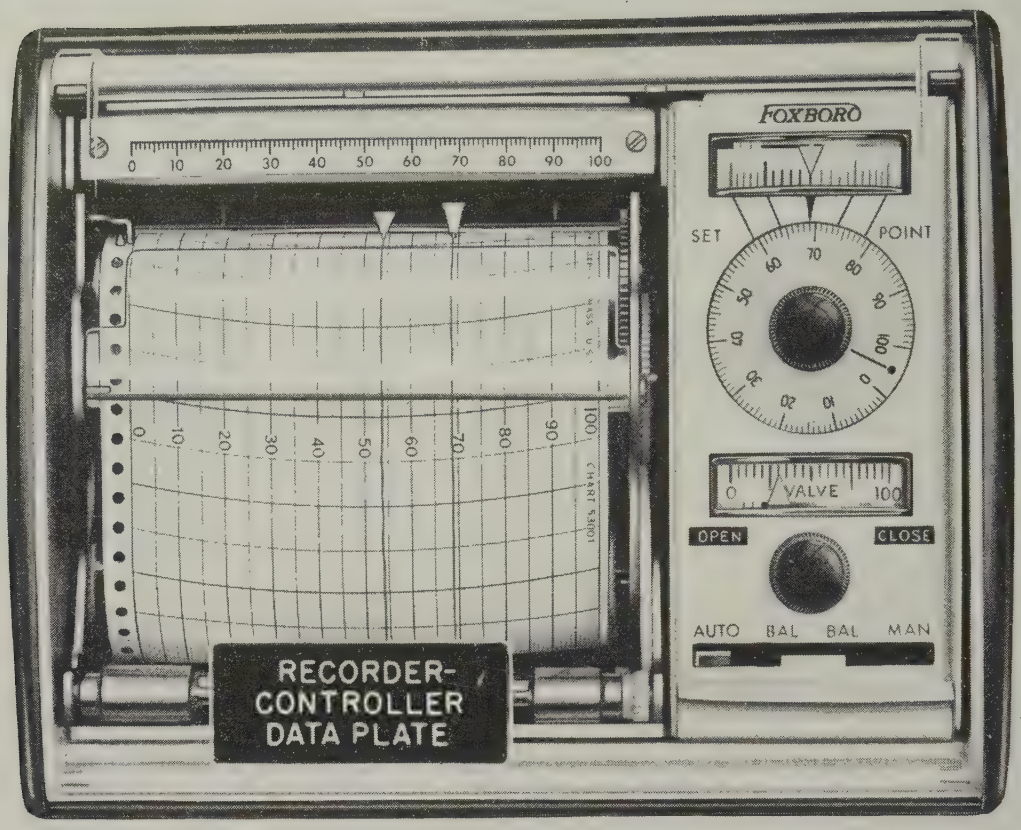


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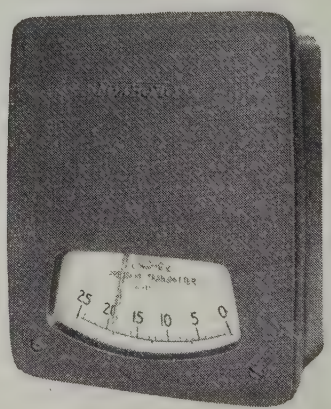

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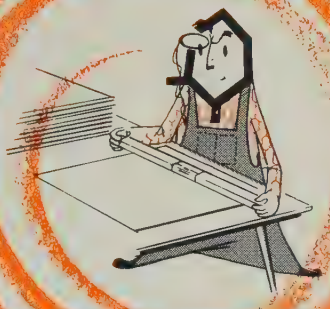

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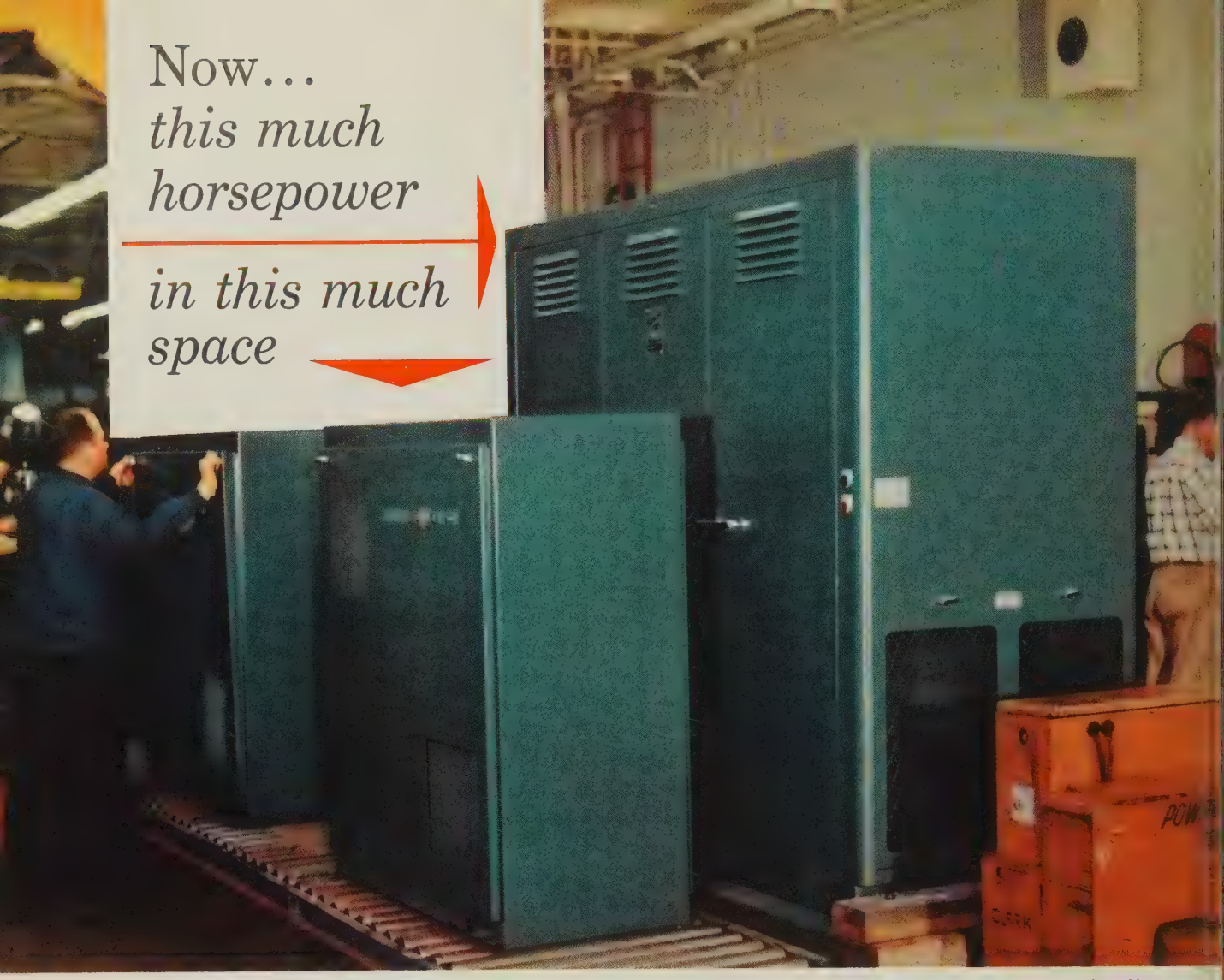


New 50 hp. Super 'T' V★S control cabinet compared with 50 hp. old style drive on Reliance production line.

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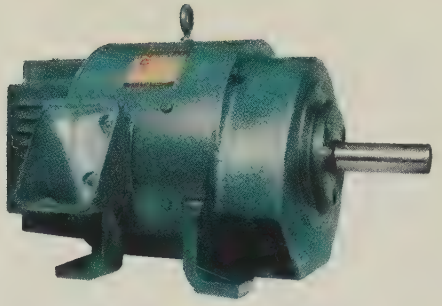
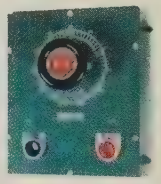
# The Super 'T' V★S Drive, a complete power package, provides variable speeds from a-c. circuits



SUPER 'T' D-c. DRIVE MOTOR



OPERATOR'S PANEL

Wide range of operating speeds from a-c. circuits adds flexibility to existing production machinery. Speed changes are stepless and can be varied while equipment is operating or stopped.

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New control relays, both a-c. and d-c. Field tested by three Reliance customers—for over 20 million operations without failure.*

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Two-bearing power units are always in alignment, eliminate bearing and coupling problems.

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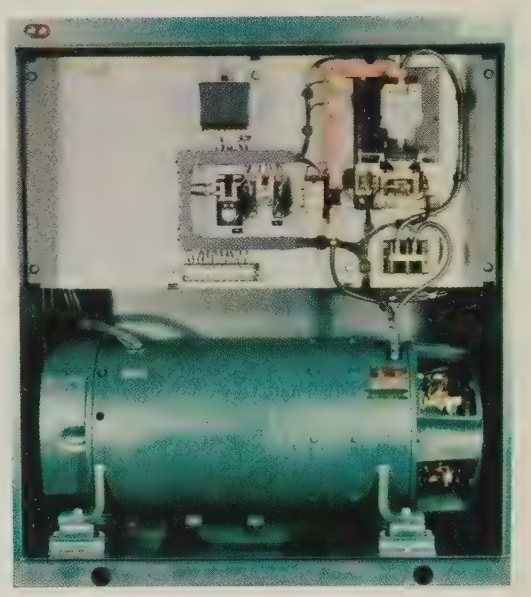
### Drive Motor

Super 'T' D-c. Drive Motors give fast response to speed and load changes, take repeated 100% overloads of one minute duration without failure.

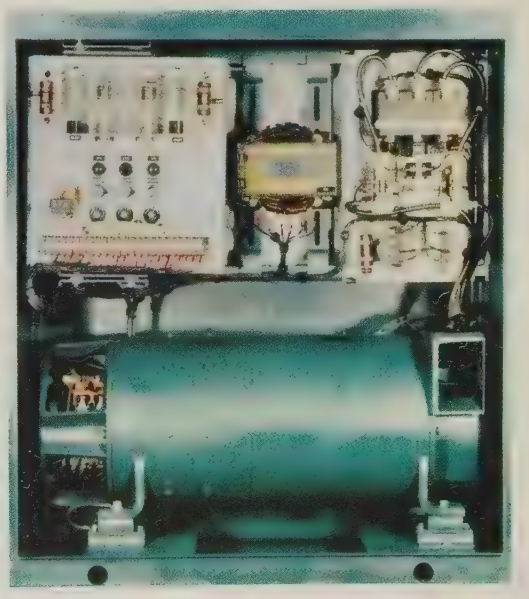
### Design

Every component designed for matched performance. New motor controls, new power unit and new drive motor provide balanced operation of production machinery.

*Names on request.

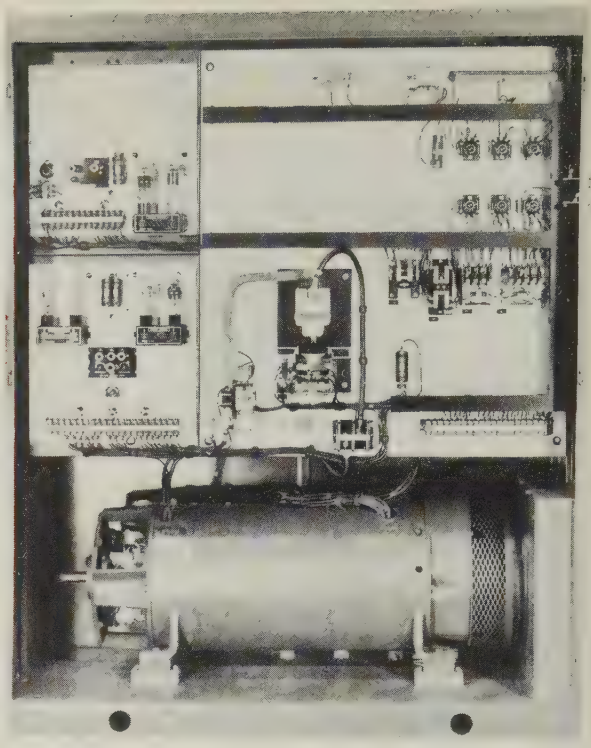


FRONT



BACK

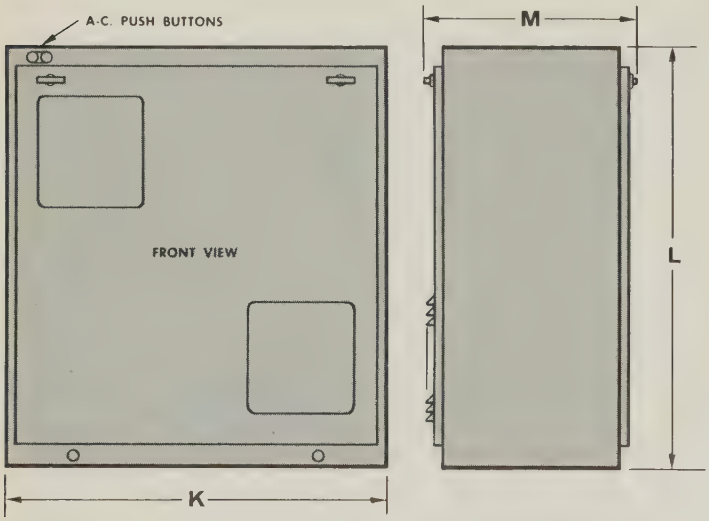
# "Custom" Super 'T' V★S Drive for more flexibility, more automatic operation



Every function of the standard model and more. Custom units are designed to incorporate additional controls for engineered installations. Custom models, through the use of feed-back regulation, will provide complete system automation. Control panels are larger to accommodate controls for regulating speed, position, torque and any other operating variables.

## Dimensions of Standard Super 'T' V★S Control

**FLOOR MOUNTED, 1-150 V★S**




Dimensions are in inches and correspond to letters shown.

| V★S HP. | CABINET DESIGN | K | L | M |
|---|---|---|---|---|
| 1-15 | 1SF | 35 | 40 | 16 |
| 20-30 | 2SF | 40 | 45 | 20 |
| 40-60 | 3SF | 45 | 50 | 23 |
| 75-100 | 4SF | 55 | 55 | 26 |
| 125-150 | 5SF | 70 | 60 | 30 |

*Product of the Reliance Electric and Engineering Company, manufacturers of a-c. motors, Master Gearmotors, Reeves Drives, Super 'T' D-c. Motors, generators, controls and engineered drive systems.*

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# Core or Juvenile Wood of Loblolly and Slash Pine Trees

BRUCE ZOBEL, CHARLES WEBB, and FAY HENSON

**Research is reported on characteristics of core wood, within a tree and among trees. This research was carried out in 1957 and 1958 in a six-state territory, mainly in the Carolinas and adjoining states. The general concept of core (juvenile) and outer (mature) wood is discussed and practical uses of the information on core wood are considered. Based on an extensive study of 670 loblolly pines of varying ages, and an intensive study of 47 slash pines and 13 loblolly pines (nine trees age 17, four trees age 50), the core wood was found to have the following characteristics: (1) Core wood specific gravity tends to vary inversely with height in tree to about 10 ft. from the base of the tree, then becomes relatively constant all the way to the 4-in. top. For practical purposes, core wood can be considered to have a uniform specific gravity within an individual tree. In marked contrast, the outer drops rapidly in specific gravity, with increasing height in the bole. (2) Core wood is considerably lower in specific gravity than mature wood of the same tree at any position up the tree. This difference becomes smaller toward top of the tree. (3) In young loblolly and slash pines there is a very close association between the specific gravity of core wood at breast height (4.5 ft.) and that of the entire zone of core wood ($r$ = 0.88 for slash pine, $r$ = 0.77 for loblolly pine). Similar close relationships exist between core wood specific gravity and the specific gravity of the total tree bole. It was found that, especially for specific gravity, the "predictive value" of core wood is high, either as an indicator of the values for the core wood of the whole tree, or for all the wood (core and outer) of the tree. (4) Cellulose yields showed the following trends: for slash pine WRC of core wood increased over 3% from breast height to tree top, while alpha-cellulose dropped very slightly from base to top of tree. Loblolly pine had a similar pattern, the WRC of the core wood increasing with height in the tree, while the alpha-cellulose remained nearly constant from base to top of the tree. A discussion of the significance of pitch depositions and heartwood formation and their effects on specific gravity and cellulose yields is included. Considerations of the value and limitations of core wood are made in addition to discussions of the significance of this concept to forestry practices.**

Wood formed near the pith of a tree has certain characteristics strikingly different from wood formed some distance from the pith. This interior zone has often been referred to as *juvenile wood*, a name that accurately describes its physiological development; however, the term is somewhat misleading in the sense that *juvenile* strongly implies wood most recently formed or wood formed only when the tree is young. The term *core* wood is better since it aptly describes its position in the tree (*37*, *38*). This paper deals with that wood formed in the growth rings nearest the pith, from base to top of tree, and will use the term *core wood* throughout because it appears more appropriate.

The existence of core wood has been recognized for a long time, but unanimity concerning its extent and importance is lacking. When genetic studies on wood were first started, it was immediately evident that information on the characteristics and extent of core and outer wood (the latter term comparable to mature wood in some publications) was needed. This information was not available, so a study of core wood was initiated, with emphasis on genetic aspects, not on wood technology or fiber yield.

Because of the genetic objective, the techniques and procedures may be different from those usually employed in wood studies. The reader is requested to bear in mind that the information was obtained for use on more complex and basic genetic studies. For example, geneticists usually sample the wood of their selected trees at breast height (4.5 ft). At this height, they have found large differences among trees in wood characteristics and quality. Are these differences indicative of the type of wood to be found throughout the usable tree bole? A portion of the study was designed to answer this question so the geneticist will know where to obtain a wood sample that has real significance.

This paper reports the results from a study of the core zone in loblolly pine (*Pinus taeda* L.) and slash pine (*P. elliottii*, Engelm. var. *elliottii*) within individual trees and among trees. It includes determinations of the relationship of wood characteristics at breast height to those of the entire bole.

## INFORMATION AVAILABLE

Since the authors have found no collating publication on core wood, a rather detailed review of some pertinent literature will be made here. The literature clearly revealed that failure or neglect to recognize the extent and properties of core wood has led to much confusion and even to erroneous research conclusions. Confusion and error have arisen where studies have been based on trees of different ages, not taking into account relative proportions of core wood, or, in numerous cases, not taking into account the large variations occurring from tree to tree. Hiley (*22*) emphasizes these points strongly in reference to the once supinely-accepted, and now much-disputed, rate of growth-specific gravity relationship.

Wood technology literature has many references to the poor physical qualities of the wood near the pith (*5*, *40*, *49*). Bethel in 1940 (*2*) pointed out to the pulp industry that the variations in wood qualities to be found among trees and wood from different locations within a tree are considerable. He states, "Apparently a core representing the first 10 to 15 years' growth contains a large percentage of very short fibers. Coupled with this is the fact that this same core contains wood of a much lower specific gravity than that of later years' growth." These important early observations were largely ignored by the pulp

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and paper industries, although a few studies, such as those by Chidester and McGovern (*9*), were an attempt to obtain information on within-tree variation.

Many of the references to core wood are relatively new. Entrican (*4*), in discussing Monterey pine (*P. radiata*), covers the subject for this species in detail in his 1957 paper. He found that at the center of the tree trunk, from top to bottom, is a core or zone about 6 in. in diameter comprising nine to 15 annual rings. Much of this core has a low specific gravity with relatively short, thin-walled fibers. Toward the top of the tree the zone constitutes the entire top log. Brodie (*7*), in his discussion of the type of tree that should be grown in Scotland, reports B. J. Rendle's contribution to our knowledge of the central core or heart of the tree. Rendle found the core to be usually of inferior quality and generally wide-ringed; therefore, it has been assumed that wide rings and poor quality are related. He goes on to explain that the central core of wood formed in the juvenile period is different in structure from the adult wood laid down later in the life of the tree; therefore, findings based on small trees with a large proportion of core wood are not of general application. Jennings (*24*), in his report from Queensland, deals at some length with core wood which he reports as being approximately 5 in. in diameter, and at the 1-ft. level, includes all the wood formed in the first 5 years of the tree's life. He reports that under forestry conditions in Queensland, density of stocking has only a very limited effect on core diameter. Jennings* also states, "The existence of the core must be recognized in the sawing pattern, because it is fundamentally unstable in seasoning, low in mechanical strength and consequently very low in value." Mottet (*33*) reported on fiber length and cell characteristics from the heart of the tree outward. He not only analyzed the fiber charcteristics, but reported on their effects on paper quality. He worked on eight separate conifers and generalizes that outer wood gives increased yields, increased tearing strength, but less tensile and bursting strength, than the "initial" wood.

Reports of very high shrinkage values for the wood found within a radius of two to three inches around the pith have been made (*35*). The wood from this central position has a relatively large fibril angle. In a report on "Juvenile Wood in Conifers," Paul (*36*), in defining core wood, states that the juvenile period is followed by growth of a more normal, mature type of wood and that the number of years involved in the change may differ in individual trees. Paul, citing 10 papers, lays stress mainly on the relationship of juvenile wood to its wide-ringed characteristic and its relationship to living crown. Again in 1958 Bethel (*4*) re-affirmed his earlier statement that properties of wood occurring near the pith are different from those of wood occurring 20 to 30 annual rings from the pith and calls attention to Harlow's (*19*) statement that wood taken from the center of the tree is not to be regarded as typical of the wood from the bulk of the stem.

Zobel and McElwee (*54*) discuss core wood (juvenile wood), especially in regard to its specific gravity and relative proportions in stands of loblolly pine of different ages. Smith (*45*) divided Douglas-fir into an inner, an intermediate, and an outer zone and found the inner zone to have a low proportion of summerwood, therefore, a low specific gravity. Summarized information on specific gravity, fiber length, and cellulose yields of southern pines was presented by Dorman (*11*). Nylinder and Hägglund (*34*) made an intensive study of spruce and found that the shape of cells change at increasing distance from the pith, as well as having a specific gravity and cell wall thickness change. Scott (*44*), working on slash pine in South Africa, reported a difference of 22 to 47 lb. per cu. ft. between inner and outer wood. Scott and Du Plessis (*43*) report a similar change for lobblolly pine grown in South Africa, noting the similarity to results found for *P. patula*, *P. insignis*, and *P. pinaster*. In their earliest reported work, Zobel and Rhodes (*51*) discussed the necessity of taking into account the juvenile core when making specific gravity studies, and presented data with the core included and excluded. Many researchers have recognized and discussed the variation in specific gravity from the core outward and upward (*15*, *17*, *25*, *28*, *29*, *47*, *50*).

Not everyone is in agreement that such a change takes place; for example, Gohre (*16*) and Drow (*12*) show that distance from pith is important in causing a specific gravity change in Douglas-fir (*Pseudotsuga menzeisii*) but Chalk (*8*) found the same density in rings near the pith as were found in the outer wood, also for Douglas-fir. It is certainly possible that different conifers, and perhaps certain species, may not show the same core-outer wood trends reported for the southern pines. Jennings† cautions on generalizations based on any one species and says that there are pronounced differences in the patterns of variation between slash pine and the native Queensland conifers *Araucaria* and *Agathis*. For example, Stillinger (*48*) reported that the specific gravity of Port Orford cedar was higher near the pith than for the wood near the bark. Similar results have been mentioned in other genera. It is not known whether in these analyses allowance was made for resins and other materials deposited in the formation of heartwood. Such depositions would cause an increase in specific gravity quite independent of cell wall density or thickness.

Fiber (tracheid) characters differ between core and outer wood. Pillow, *et al.* (*39*), and Scott and MacGregor (*42*) discuss fibril orientation changes in this zone for loblolly pine and a number of other conifers. Intensive studies have been made on fiber length changes of a number of species including loblolly, slash, and Monterey pine (*3*, *5*, *10*, *18*, *20*, *23*). They are in agreement that fiber length increases from the pith outward, at least for some distance, and they note length variation up the stem. Kramer (*27*) made a detailed study of the relation of fiber characters in core and outer wood for loblolly pine, finding that there is a rapid increase the first few rings from the pith followed by a later less rapid change.

## RESEARCH METHOD

The research reported here is based upon sections made from stump to top of 47 slash pine trees and 14 loblolly pine trees, as well as breast height (4.5 ft).

* Personal communication, 1958.

† Personal communication, 1958.

samples from 670 loblolly pines. The slash pines were obtained from plantations in the sandhills of South Carolina, ranging in age from 9 to 25 yr.‡ They were sectioned every 5 ft., from 1 ft. up to a 4-in. diam. The loblolly pines were from the coastal plain of North Carolina, one group of nine being 17 yr. old, the other five about 50 yr. in age. These loblolly pines were more intensively investigated than the slash pine, having been sectioned every 2 ft. up to a 4-in. diam. They were the same trees used in a study of compression wood in loblolly pine (*21*).

The rather large amount of data reported in this paper on core wood variation at breast height among trees and among stands is based upon characteristics exhibited by many hundreds of loblolly pines growing throughout North and South Carolina, Virginia, Tennessee, Georgia, and Alabama. It represents trees selected from the dominant and codominant tree classes for genetic studies and which were growing under many different environmental conditions. No intermediate or suppressed individuals were sampled. Wood samples consisted of two "over-size" (11 mm.) increment cores per tree.

The wood of each tree was divided into core (juvenile) and outer (mature) wood (*54*). A somewhat detailed discussion of the method of division is warranted here, since it is admittedly arbitrary but very useful and reproducible.

In a cross section of a log, or on an increment core, the wood near the center of the tree looks different from the wood at some distance from the pith. It has a "dull" or "lifeless" appearance, especially when dry. It usually has a low springwood-summerwood ratio. There is usually a gradual transition from springwood to summerwood, giving it a different appearance from the mature wood where the transition is often more abrupt (Fig. 1). In older trees the appearance of the corewood is changed by the formation of heartwood,

‡ Material collected and furnished by Southeastern Forest Experiment Station, U. S. Forest Service, as samples in a study of volume weight relationships of slash pine.

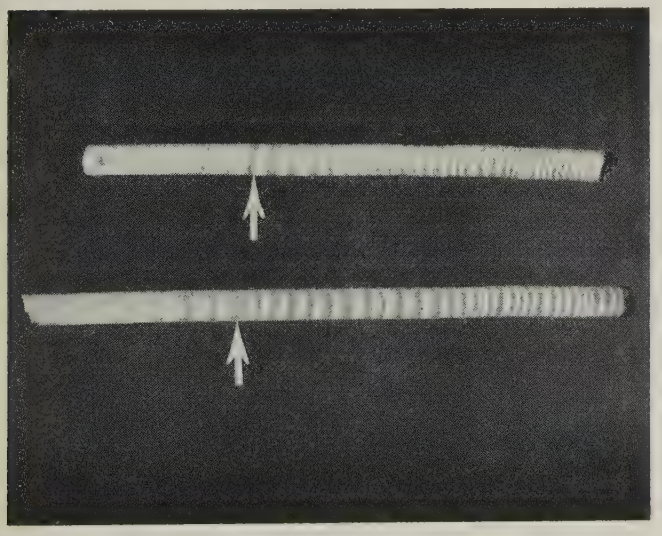

***Fig. 1. The points of division into core and outer wood are shown by arrows in the photograph***

The shorter increment core has a rather abrupt change and is easy to separate. The longer increment core has a more gradual change and is more difficult to separate. Note rings in "transition area" toward the pith.

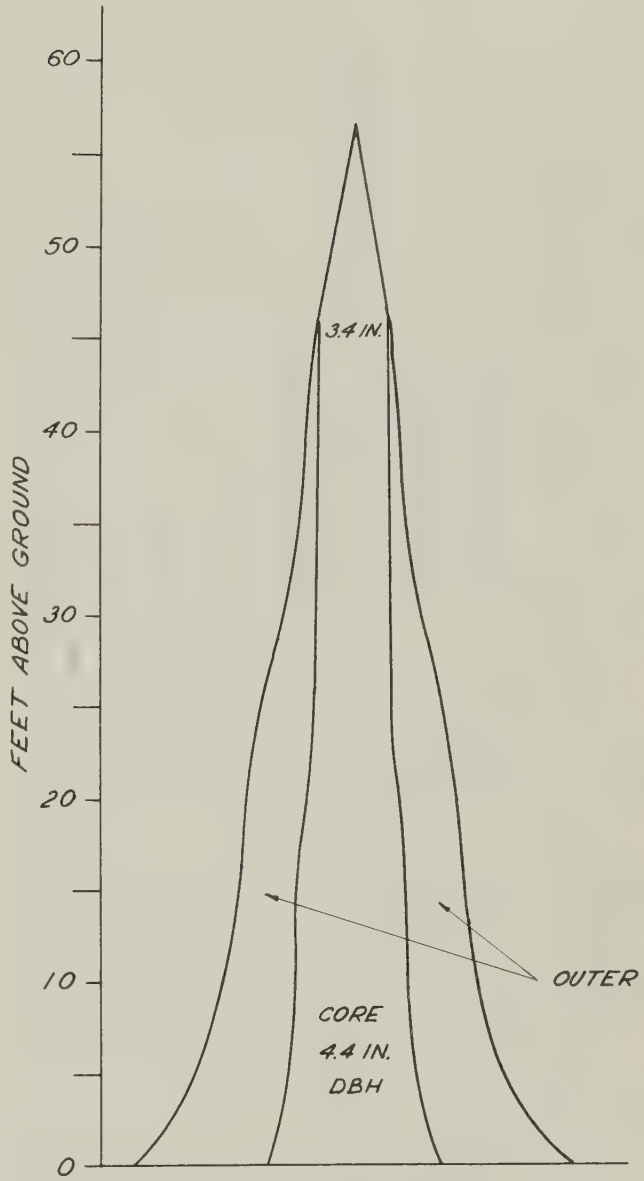


***Fig. 2. This represents an actual plotting of the appearance of the core for the sample loblolly pines***

Core size as shown is determined by basal area rather than diameter—but figures represent diameter.

but this rarely exactly coincides with the core wood region. Thus, the separation of core wood, by our method, is based purely on appearance. As pointed out earlier (*54*), there usually is no sharp line of division, but there is a transition zone between the core and outer wood. When dividing into core and outer wood, an attempt is made to include the transition zone in the core wood portion.

In studying the sections throughout the bole of individual trees, samples were obtained from all trees, labelled with key numbers and thrown together in a box. These sections were then marked into core and outer wood portions; data on size, specific gravity, and cellulose were obtained, and then the data reassembled into tree form. In all the studies, the core region was delimited by visual estimate, irrespective of years of growth. It was only after marking the core limits that the rings were counted.

Specific gravity determinations were made by the standard water displacement method of volume

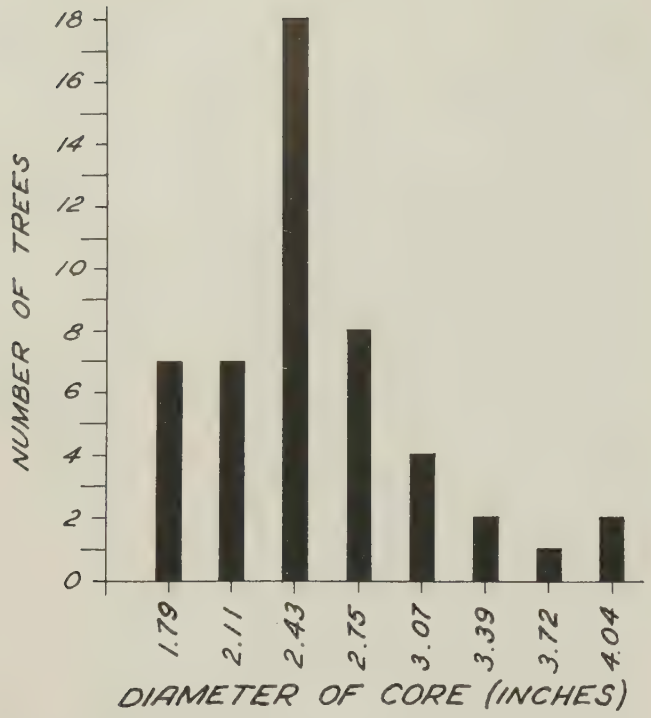


*Fig. 3. Size of core is rather constant throughout one tree (growth under uniform conditions); however, average size of core varies greatly among trees, as shown by the 47 slash pines sampled*

determination: Specific gravity is the ratio of dry weight to green volume.§ The method of cellulose determinations and description of the water-resistant carbohydrates (WRC) and alpha-cellulose are given by Zobel and McElwee (*55*). The same methods, with some refinements, were used in the present study.

## RESULTS

### *Variation of Core Wood Within a Tree*

All previous researchers have reported that there is a difference in wood properties from the stump to the top of the tree. Most of these reports are based upon full cross sections, usually from a sample of a single tree, or very few trees. None has approached this problem from the standpoint of separate variations within the juvenile and mature portions of the tree. This study was specifically oriented to determine the variabilities of core and outer wood.

### *Size of Juvenile Core and Years of Production*

The core in the nine 17-yr.-old loblolly pines is nearly cylindrical in shape (Fig. 2), tending to become a little smaller with height, decreasing from 4.4 in. at breast height to 3.4 in. at a height of 45 ft. However, the core in the 47 slash pines was cylindrical, averaging 2.5 in. in diameter all the way up the tree. Average core size of individual slash pine trees varied considerably, ranging from 1.6 to 4.2 in. (Fig. 3). When averaged, the 670 trees, sampled only at breast height, had a core diameter of 3.6 in.

One important factor is the period of time each individual tree tends toward the production of core wood. As previously indicated, the core was marked without regard to number of rings and only after marking were the rings counted. There is a strong tendency for number of rings in core wood to remain relatively constant for any given individual tree. There is, understandably, some variation, due in part to the non refined method of determining core wood. For slash pine, the average period of core wood formation varied from 5 to 8 yr. among individual trees; however, an accurate ring count is often very difficult near the pith. For individual loblolly pines the ring count varied from 7 to 11 yr., with a tendency for a tree that is high in ring count at breast height to stay high in every section up the tree. For the 670 loblolly trees studied at breast height, core wood characteristics were discernible to approximately the eighth ring from the pith. As a conservative limit for loblolly pine, a zone 10 rings from the pith should include both the core and transition wood.

Paul (*36*) feels that juvenile wood and wide rings are inseparable. He goes on to state: "Thus it may be observed that all forests or forest trees do not begin growth under conditions that produce initially wide-ringed wood. When initial growth rings are narrow, changes in specific gravity from the pith outward may be negligible. Then the initial narrow-ringed wood is not regarded as juvenile wood." Our findings do not confirm Paul's contention. On some sample plots trees were found with the rings in the core extremely close, but still both specific gravity and cellulose yield were low. In fact, of the many trees sampled to date in the Southeast, only three trees have been found in which either specific gravity or cellulose yield (at breast height) of the core wood equals or exceeds that of the outer wood. Scott and MacGregor (*42*) found that low strength of the wood near the pith is independent of specific gravity and ring width, whereas, Rendle and Phillips (*41*) state that the change-over from low density "juvenile" wood to wood of adult density is related to distance from the pith as counted in rings rather than as measured in inches. Thus, a stem that grows rapidly in early years will usually have a larger core of low-density wood than a tree of slower initial growth, although the densities of the two cores may not be very different.

Occasionally a tree is found in which it appears that typical core wood is lacking, but even in these instances the phenomenon is independent of growth rate. In Texas, Zobel and Rhodes (*51*) found a few trees that had outer wood with unusually high specific gravity and with core wood that appeared quite similar to outer wood, also containing a high specific gravity. A number of individuals have suggested that such specimens may provide an opportunity for developing strains of trees that do not have typical core wood. This possibility may well be so, but so far, no selections have been made with the objective of reducing the amount of core wood.

A word of caution needs to be interjected here. The trees sampled were grown under uniform conditions, with no silvicultural treatments having been made on the stand during its lifetime. The sample trees were all dominants or co-dominants growing at a fairly rapid and uniform rate. The core wood would

§ For these studies the wood samples could not be oven-dried because the cellulose determinations will be adversely affected. Therefore, the samples were placed in a constant temperature-constant humidity room and allowed to come to an equilibrium. The wood samples remained in this room for several weeks. Under the conditions used here, the wood came to approximately 9.1% E.M.C. This figure was then used to calculate the dry weight of wood in the specimen. The dry weight thus calculated was used to determine the specific gravity.

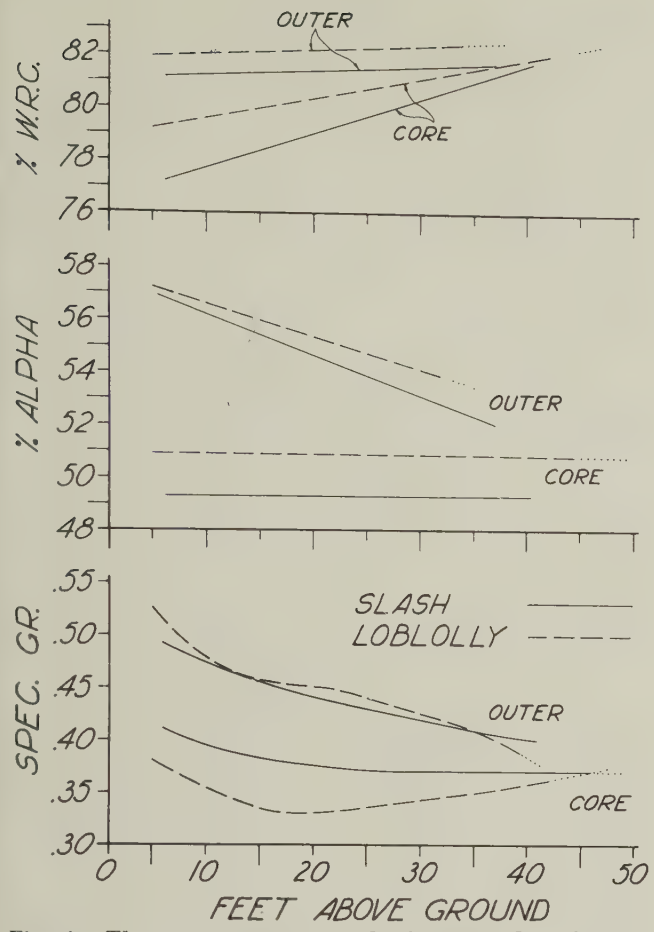


***Fig. 4. These are average results for a number of young slash and loblolly pines (see text) showing the change in specific gravity, alpha-cellulose and WRC with height in tree, for core, and outer wood***

Note the reversal slope of the lines for alpha-cellulose and WRC.

probably cease to be cylindrical in a tree that had a sudden quickening of growth following release. It is important to recognize this possibility. Many papers, such as Jennings' (*24*), refer to holding down the size of the core by planting at close spacing when young, then releasing for fast later growth. If the trees could be grown close enough together, this practice might prove effective for the lower portion of the bole. However, a later increase in growth rate will cause an increase in the size of the cylinder of core wood higher up the tree. Release, say after 15 yr. of suppression, will result in a juvenile core of wood that is small at the base of the tree, but which will flare out higher up the bole as more rapid growth takes place in the tree. Actually, as Jennings (*24*) points out, it is impossible to hold down the size of the core under spacings generally used in forestry. It is rather obvious that core wood will be present and it must be recognized that the faster the growth, the larger the core in the portion of the bole affected. Variations in size of core wood are thus due to two things: (1) the rate at which the tree grows during the formation of core wood, and (2) the number of years that the tree tends toward production of core wood.

### *Specific Gravity of Core Wood*

It has long been recognized by many researchers (for example, (*2*) and (*29*)) that the specific gravity of wood varies inversely with the height at which the samples are taken from the tree. However, there are no reports to show how specific gravity of core wood varies in relation to height of sample.

Present research results indicate that for slash pine from breast height to top, there is a slight drop in specific gravity for a short distance, then a leveling off to the top of the tree's bole (Fig. 4). Loblolly pine showed a very slight increase in specific gravity with height after a small initial drop. The bulk of the drop in specific gravity normally observed for the complete bole at higher levels in the tree is due to a rapid drop in the specific gravity of the outer wood at these higher levels. This is different from Jennings'|| report, in which he states that for slash pine the bulk of specific gravity drop was in core wood, with little drop in outer wood. He recognizes heartwood formation in the young trees (about 10 yr. of age) which causes a large fluctuation in core wood density values. Although boles were analyzed from the 1-ft. level on up, it was noted that the section of the bole below 3 ft. gives very unpredictable and erratic results. Therefore, all relationships reported here are based on the 3-ft. level or on breast height (4.5 ft.) or higher.

The lack of a consistent lowering in specific gravity of core wood with height is interesting from a physiological standpoint. This wood has been called juvenile wood because it is that wood laid down nearest the pith, i.e., produced in the juvenile "phase" of growth. The constancy of such characteristics as specific gravity, alpha-cellulose yield and fiber length make the "juvenile phase" idea appear to be meaningful. For example, Greene (*18*) found the initial fiber length near the pith to be relatively constant all the way up the tree, although the average fiber lengths produced in the outer wood may be variable at different heights. Hata (*20*) reported the same thing, but found a length increase from ground level to about 9 ft., then a constant length for the remainder of the bole. It would be expected that near the base of older trees the specific gravity of the core wood might rise due to the onset of heartwood formation with its resultant resin depositions and chemical changes. In fact, this change probably does occur and may be encountered in wood samples from which the resins have not been extracted.

However, one puzzling fact has been observed; i.e., at breast height, older trees have consistently higher average core wood specific gravities than trees from younger stands nearby. To ascertain the possible cause for the higher values, specific gravity of cores from three age classes of loblolly pine was determined, all sample trees being from the *coastal plain* of North Carolina. After obtaining the specific gravity in the usual manner, the same wood samples were extracted for 2 days in Soxhlet extractors (with alcohol-benzene) until in the final liquid change, no color was present. Specific gravity of the extracted wood was 0.03 lower, but the trend with age group was consistent, the oldest trees still retaining the highest specific gravity following extraction (Table I).

Analysis of variance showed that: (1) differences in specific gravity between individual trees were highly significant; (2) differences between each of the four age classes were highly significant; (3) the difference

|| Personal communication, 1958.

**Table I. Specific Gravity of Core Wood of Loblolly Pine by Age Class, at Breast Height, Before and After Extraction**

| No. of trees | Age class, yr. | Average specific gravity — Before extraction | Average specific gravity — After extraction | Mean |
|---|---|---|---|---|
| 24 | 15–29 | 0.42 | 0.40 | 0.410 |
| 24 | 30–39 | 0.45 | 0.42 | 0.435 |
| 24 | 40–49 | 0.46 | 0.43 | 0.445 |
| 24 | 50+ | 0.49 | 0.46 | 0.475 |
| Average | | 0.46 | 0.43 | |

L.S.D. 0.01 for age means is 0.005

due to treatment was highly significant; and (4) the interaction between treatment and age classes was very small and nonsignificant.

No immediate explanation can be given for this phenomenon since, according to the wood technologists and anatomists, no additional cellulose is laid down in the core zone as the tree becomes older. It is also of interest that cellulose yields were usually lower from the core wood of older trees. This would make it appear that some noncellulosic substance, not easily extracted by alcohol-benzene, is contributing to the greater weight of core wood from older loblolly pines.

### *Cellulose Yields*

As previously described, two types of cellulose analyses were made, WRC (water-resistant carbohydrates) and alpha-cellulose. The yields reported here are all based on dry weight,¶ *not volume*, of wood used.

From the base (3 ft.) to the top of the tree WRC yields of core wood increase about 3 or 4%; however, at the same points alpha-cellulose of core wood tends to remain about constant (Fig. 4). It is of interest to note also that WRC yields in outer wood do not follow the same pattern as those for core wood, even though the wood is taken from the same location (height) in the same trees. Cellulose yields are always lower for core wood than they are for outer wood at the same location in the tree's bole (Fig. 4).

Since the curves in Fig. 4 are composites of several age classes, they show only the general trends, not the precise relationships for each age class. Age clearly makes some difference, but detailed discussion of this variable and others in relation to both core and outer wood will be deferred for inclusion in a more detailed report to be made later.

### *Effects of Heartwood and Resin Deposition*

While working with core wood, due care must be exercised to recognize the presence of pitch depositions and heartwood. Cellulose determinations made on dry weight of nonextracted wood should be considerably lower for pitchy wood than if the pitch had previously been extracted. To illustrate the magnitude of the yield differences, a series of cellulose determinations were made with normal core wood, normal outer wood, and excessively pitchy wood before and after extraction. Substantial increases in cellulose yield due to extraction were found, especially in the pitchy and core wood (Table II).

A statistical analysis of the data in Table II shows that the treatment effects are very highly significant, that the different types of wood are highly significantly different and that the interaction between treatment and wood type are highly significant.

These results strongly indicate that any visible pitch samples must be excluded from cellulose determinations. Accordingly, the general results reported in this paper include no cellulose determinations on trees that had visible pitch depositions. In core wood, such depositions are rather common and many wood samples were taken from trees that could not be used. Pitch pockets in outer wood are relatively rare in loblolly pine.

Of considerable interest are the effects that pitchy wood has on specific gravity. As shown by Table I, in unextracted wood, pitch raises the apparent specific gravity, although the absolute wood content remains unchanged. How much of the regional and tree-to-tree differences in specific gravity are due to differences in pitch content rather than to differences in wood substance as such? It is known that the number of resin ducts vary with individuals, tree position and growth characteristics (*31*). The number of radial resin ducts are highest during early age (i.e., in core wood) and then decrease rapidly until about the twentieth year, after which it levels off. Many authors, including Mergen (*30*) and Dudic (*13*) discuss the inheritance pattern of gum yields and show that there is a large tree-to-tree variation. The amount of resin contained in the wood must be considered in both specific gravity and cellulose studies. No data are presently available on regional or site differences in this characteristic.

Heartwood presence is a more difficult problem. Heartwood is defined by the Society of American Foresters (*46*) as: "The inner core of a woody stem, wholly composed of nonliving cells and usually differentiated from the outer enveloping layer (sapwood) by its darker color." It is recognized by most foresters as usually occurring in older trees, in loblolly pine not usually being evident until after the tree is about 30 to 40 yr. old or older. Jennings* found heartwood in slash pine in Queensland as early as 10 yr. of age in

* Personal communication, 1958.

**Table II. Yield of Cellulose from Extracted and Nonextracted Loblolly Pine Wood**

| Wood sample | Cellulose yields[a] — Normal[b] WRC, % | Extracted[c] WRC, % | Average both WRC, % | Normal[b] alpha, % | Extracted[c] alpha, % | Average alpha, % |
|---|---|---|---|---|---|---|
| (Normal core wood, normal outer wood and excessively pitchy wood) | | | | | | |
| Normal core | 76.2 | 80.2 | 78.2 | 49.6 | 52.8 | 51.2 |
| Normal outer | 80.4 | 82.0 | 81.2 | 57.3 | 58.8 | 58.1 |
| Extra pitchy | 66.5 | 78.3 | 72.4 | 44.4 | 52.8 | 48.6 |
| Mean | 74.4 | 80.2 | 77.3 | 50.4 | 54.8 | 52.6 |

[a] The three types of wood were ground and mixed separately. Then 12 samples were drawn from each wood type and analyses made. Percentages reported are an average of the 12 separate determinations for each type of wood and for each treatment.
[b] Yields based on dry weight of normal (nonextracted) wood.
[c] Yields based on dry weight of extracted wood.

¶ The wood is ground in a Wiley mill and screened through a 20-mesh screen. Then it is put into the constant temperature-humidity room for a minimum of 2 weeks, until moisture equilibrium is attained. The dry weight is then calculated from the constant EMC.

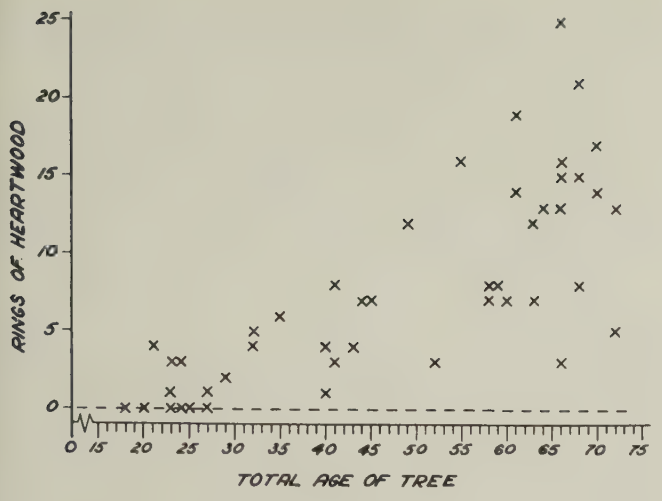


***Fig. 5. "Chemical heartwood" for loblolly pine is not in evidence below 20 yr. of age and very little is present below 30 yr. of age***

Note how some relatively old trees show very little "chemical heartwood." Heartwood, in the forester's sense, is usually not present in trees younger than 30 to 40 yr. of age.

the basal portion of the stem. Heartwood formation was not observed in the slash pine used in this study. H. G. Taylor,** Rayonier Inc., states that in relatively young slash pine they find a "heartwood" which cannot be pulped by their sulphite cooking method. They use a chemical test†† that turns the "heartwood" red.

Although most trees showed little visible heartwood at breast height, this test was used on 50 loblolly pine trees from the Coastal Plain of North and South Carolina. The trees ranged in age from 18 to 72 yr. The results are shown in Fig. 5. Note that only three of the 15 trees under 30 yr. of age had more than two rings from the pith that indicated presence of "heartwood." In the older trees it was common to find 15 or more rings exhibiting the reaction, though some of these showed little or no evidence of "typical" heartwood formation. When calculated on a diameter basis, only two trees younger than 40 yr. showed more than a 2-in. diam. core of "chemical heartwood" at their center. In some trees the color change coincided exactly with the core wood; in others it went many rings into the outer wood, and in still others it was essentially lacking, even in the core wood.

Although this paper is not the place to further discuss the question of heartwood formation, it would appear from our limited data for loblolly pine in the Carolina Coastal Plain that neither "standard" nor "chemical" heartwood is of too great importance in the rotation age commonly followed by foresters in this area, i.e., 25 to 45 yr.

## VARIATION OF CORE WOOD AMONG TREES

When working with many trees, one fact was immediately evident; i.e., characteristics of both core and outer wood varied greatly between individual trees, no matter under what conditions they were growing. If a number of dominant and co-dominant trees of the same age are selected from one site and growing under uniform environments, results are always in good agreement with previous determination

** Personal communication, 1958.

†† Consists of a mixture of benzidine dihydrochloride and sodium nitrite that reacts with the stilbene complex and forms a red color.

**Table III. Average Specific Gravities, Core Sizes, and Years of Core Wood Formation for Loblolly Pine in Different Geographic Regions, Based on Samples Taken at Breast Height**

| *Region* | *Sample trees, no.* | *Core wood, spec. grav.* | *Outer wood, spec. grav.* | *Size of core, in.* | *Duration of core formation, yr.* |
|---|---|---|---|---|---|
| Coastal Plain S. C. & Ga. | 85 | 0.44 | 0.55 | 3.8 | 7 |
| Coastal Plain N. C. & Va. | 226 | 0.44 | 0.55 | 3.8 | 7 |
| Peidmont-Ga. & West S. C. | 40 | 0.44 | 0.54 | 3.4 | 7 |
| Peidmont-S. C. | 25 | 0.44 | 0.53 | 3.8 | 8 |
| Piedmont-N. C. | 38 | 0.44 | 0.52 | 3.4 | 7 |
| High Peidmont-N. Ga. & S. Tenn. | 24 | 0.43 | 0.51 | 3.2 | 6 |
| N. W. Louisiana | 20 | 0.43 | 0.50 | 5.2 | 8 |
| Weighted average | | 0.439 | 0.541 | 3.76 | 7.0 |

on specific gravity variations (Fig. 6). For exactly the same group of trees, alpha-cellulose followed a similar pattern of variation (Fig. 7). This variation pattern also holds true for WRC. It appears that no matter what the environmental conditions may be, there is always a large spread in cellulose yields and specific gravities among individual trees. This magnitude of variation among individuals seems to hold equally for core and mature wood. There is no method presently known which permits estimation of specific gravity or cellulose yield of the wood of an individual southern pine from outward appearance, whether the wood is from the core or the outer portion of the tree's bole. However, for certain species, such as *Abies lasiocarpa* (*25*), both wood specific gravity and fiber length could be estimated from the appearance of the tree's bark.

### *Geographic Variation in Core Wood*

Although core wood characteristics vary greatly from tree to tree, it is of importance to determine if there is an average regional trend, i.e., are core wood characteristics different in different regions or are there important interactions of site and region. The trees examined for possible trends are roughly grouped in

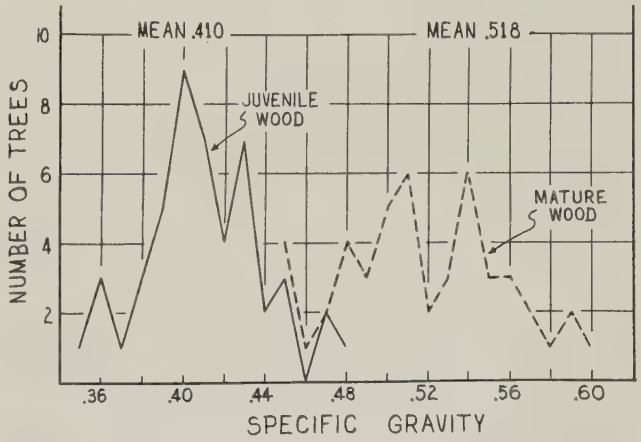


***Fig. 6. A large variability pattern is always evident in both core and outer wood specific gravity of loblolly trees of the same age growing on the same site. Juvenile wood is synonomous with core wood, as mature wood is with outer***

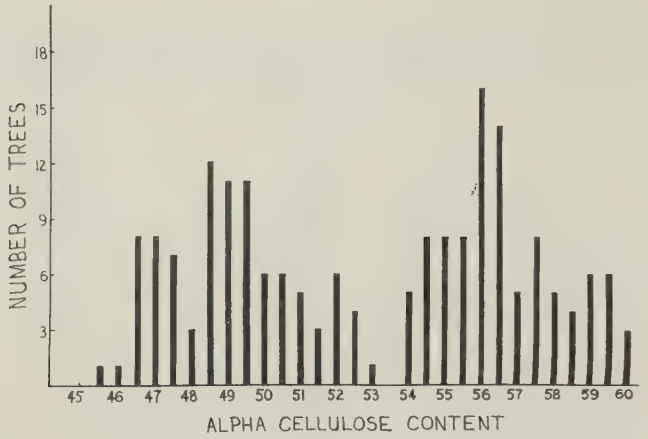


*Fig. 7. Variation in cellulose among trees of the same age growing on the same site always is considerable*

To the left are the cellulose values for core wood; to the right are values for outer wood. Distribution pattern is similar to specific gravity.

Table III. The areas are not finely delineated and the values shown are only for the selected trees‡ for each area. This sample, therefore, does not represent a cross section of all types of trees to be found in the stand, but it should give an indication of any geographic trends present in the most desirable phenotypes.

No real trend seems to appear in geographical values for specific gravity of core wood. Without evaluating the data statistically, it appears there is a trend in outer wood; it shows a drop in specific gravity in the more inland areas. It is interesting also that the years of juvenile wood production seem to be about the same in all geographic areas, with the possible exception of the high Piedmont. Sufficient data are not yet available to show any geographic trend of cellulose yields in wood. In every area studied, however, the average core wood yields in alpha-cellulose were about 7% lower than the yields from outer wood.

No relation has been observed between growth conditions and core wood characteristics. This finding agrees with that of Klem (*26*), who found that for spruce there was no effect of planting spacing on the inner zone of wood.

## PREDICTIVE VALUE OF CORE WOOD

### *Relation Between Breast Height and Total Tree Core Wood*

Sampling procedures in genetics work usually consist of examining the wood properties of selected trees at breast height. But do the breast height values accurately indicate the characteristics of wood for the whole tree? A determination of the reliability of breast height measurements as indicator of total bole characteristics is absolutely essential for accurate and rapid testing for wood genetic studies.

In order to determine this relationship, correlations were made for specific gravity and cellulose yields on core values for individual trees at breast height and the values for the total core wood contained in the entire tree bole.

Both specific gravity and cellulose yields at breast height were found to be highly correlated with the values for core wood of the whole tree (Table IV). These relationships are for both young loblolly and slash pines (not over 25 yr. of age). In view of the findings mentioned of increasing specific gravity with age of tree, this relationship will need testing on older trees.

‡ Trees selected for use in seed orchard programs of industry. These are the best formed, fastest grown trees available.

**Table IV. Correlation Coefficients Between Breast Height Core Values and Total Core Volume in Slash and Loblolly Pines**

Basis: loblolly specific gravity—14 trees; slash specific gravity —48 trees; cellulose—both species, based on 10 trees of each

| *Characteristic* | *Slash pine correlation coefficient (r)* | *Loblolly pine correlation coefficient (r)* |
|---|---|---|
| Specific gravity | 0.886[b] | 0.770[a] |
| WRC | 0.933[b] | 0.829[a] |
| Alpha-cellulose | 0.943[b] | 0.806[a] |

[a] Significant at 1% level.

It must be pointed out that the analysis introduces some automaticity; i.e., the breast height value used for predictive purposes is also a portion of the value used to characterize the total tree bole. It is obvious that the expected coefficient of correlation between a part and the whole is not zero (*6*). The prediction is to estimate what the whole bole contains from the value at breast height, which is, of course, part of the total tree value. Since the portion contributed by the breast height sample is normally small in relation to the entire core volume, failure to start with a zero hypothesis may not be too serious. A glance at the paired values and the plotted values show that a high core value is associated with a high tree value, the desired relationship, even though the correlation cofficient as usually applied may be questioned.

### *Relation Between Core Wood and Total Wood in the Bole*

Although the relationship between core wood values at breast height and total core values for the tree are interesting and useful, it is of greater interest to see if a relationship exists between breast height core wood values and values for the total merchantable tree volume, including both core and outer wood to a 4-in. top in young slash and loblolly trees. This relationship for cellulose will be developed in a later paper; however, for specific gravity, very high relationships were found. (Slash pine $r = 0.798$ and loblolly pine $r = 0.890$). Here the automaticity introduced is very minor in nature, since the volume of the predictive core is extremely small, compared to the total volume of the tree. This opens up very interesting possibilities of predicting specific gravities of mature trees or stands from young trees. In effect, it indicates that you may be able to tell the characteristic of the whole tree's bole, especially specific gravity, from the core wood alone. In effect, once one can predict what the tree will produce from the young sapling. Such predictions would be invaluable in research and might be used also in estimating yields from different stands. For any specific area to be worked, a series of trees could be sampled and from this series a regression equation could be calculated. Then one could predict for trees of the same age and growing under the same conditions as the sample trees the specific gravity and

perhaps cellulose yields that will be attained by a group of young trees. The same age, same environment restriction needs to be adhered to until comprehensive enough studies have shown the changes, if any, in the slope of the regression line with age or growing conditions. The data reported here indicate that core wood may be very valuable as such a predictive tool for use by the forest manager and the researcher.

Others have found similar relationships for total tree cross sections. Hoop pine (*1*) (*Araucaria cunninghamii*) in Australia was found to have values at breast height that were correlated to total tree value. For loblolly pine in Mississippi, Mitchell (*32*) reports the correlation coefficient for specific gravity between breast height and total tree bole to be 0.7209. Thus, it would appear that the values obtained at breast height are indicative of values for the total volume of wood of the tree.

To illustrate the relationships, Fig. 8 indicates curves for specific gravity and alpha-cellulose for trees with extreme values and for the average of all trees at breast height. Note how any tree with an initially high value stays relatively high at successive heights throughout its total length.

### *Relation Between Core Wood and Outer Wood at Breast Height*

In addition to obtaining an estimate of total tree characteristics from breast height values, there is also a need to predict wood qualities of an older tree from those of young trees. Therefore, the question arises: If the core wood is high in specific gravity or cellulose yields, will the outer wood also be high? A number of correlation studies have been made to determine this relationship. Some early results, taken at breast height, were reported by Zobel and Rhodes (*52*, *53*). They found coefficients of correlation between core and outer wood specific gravities in the order of $r = 0.8$. Similar, though lower, values were found in the present study for specific gravity, when sections taken up to 11 ft. were used to estimate relationships. As can be seen from Table V, however, the 64 loblolly pine samples in the present study has an $r$ value of only 0.335 although this low correlation coefficient was significant at the one per cent level.

When relationships were determined for cellulose on preliminary studies (*54*), correlations between core and outer wood at breast height were significant at the 1% level, but the numerical values of the coefficients (0.5 to 0.6) were rather low. When similar relationships were determined for the small number of slash and loblolly pine which were sampled throughout

**Table V. Correlation Coefficient of Core to Outer Wood Up to 11 Ft. in Height**[a]

| *Kind of trees* | *Characteristic* | *No. observations* | *r* |
|---|---|---|---|
| Slash | Spec. grav. | 74 | 0.679[b] |
| Loblolly | Spec. grav. | 64 | 0.335[b] |
| Slash | WRC | 19 | 0.303 |
| Loblolly | WRC | 37 | 0.725[b] |
| Slash | Alpha-cellulose | 19 | 0.115 |
| Loblolly | Alpha-cellulose | 28 | 0.148 |

[a] Sections analyzed were at 6 and 11 ft. for slash and 3, 5, 7, 9, and 11 ft. for loblolly pine.
[b] Significant at 1% level. Others nonsignificant.

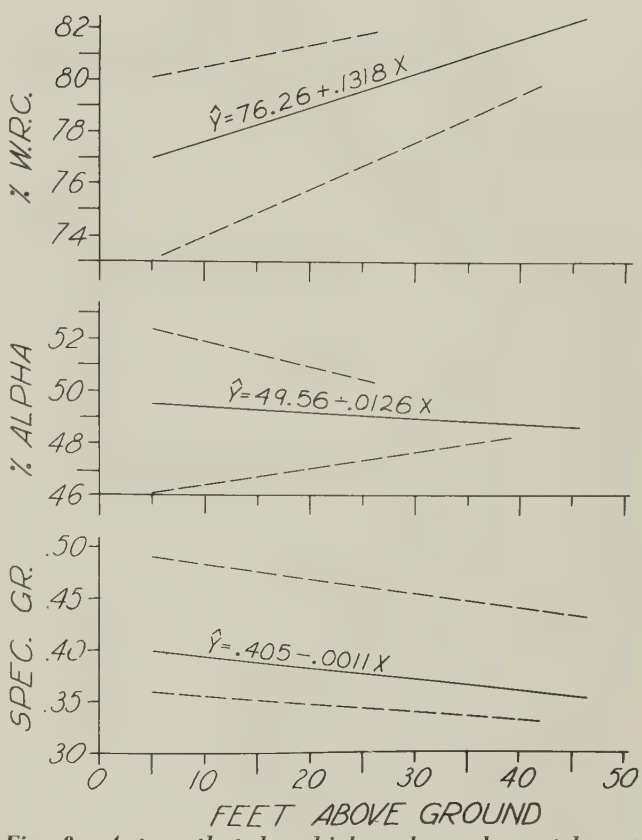


***Fig. 8. A tree that has high or low values at breast height remains relatively so throughout the total tree height***

The dashed lines represent individual trees with high and low breast height values for specific gravity and cellulose. For comparison, the solid lines with indicated regression equations show the average values for all trees studied. The trees that had high and low values for WRC were the same trees that had high and low values for alpha-cellulose. Upon analysis ($t$ value) the regression coefficients for WRC and specific gravity were significant at the 1% level, while the alpha-cellulose was significant at the 5% level. All data were for slash pine.

their length is this study, reasonably high correlation coefficients were obtained only for WRC of a set of 37 loblolly pine samples (Table V); all others were low or nonsignificant. It appears, therefore, the predictive value of cellulose yields is more erratic and that it will be more difficult to predict cellulose yields than specific gravity from core wood, or from young trees. It is perhaps surprising that relationships as good as reported were obtained, because of the strong tendency for pitch depositions in core wood. Although all specimens containing visible pitch were discarded, sometimes considerable excess pitch may be present but not recognized. If this occluded material is not separated, it makes cellulose yields appear low when the yield is calculated on weight of dry wood before pitch is removed.

## DISCUSSION

It is commonly recognized that there is a difference between the wood produced at the heart of a tree near the pith and the wood produced at some distance from the pith. The present study reports on an attempt to obtain an estimate of the relative amounts, proportions and properties of core wood, compared to outer wood. This attempt has not been made previously, possibly because the core and outer wood zones are not discreet and there is no definite dividing line between them.

They grade from core to outer wood through a transition zone where the change in characteristics becomes less abrupt and the curve of wood characteristics tends to level off.

The authors have made an attempt to evaluate the properties and amount of core wood by a rather crude, but reproducible, method. The core wood is recognized by its characteristics of having little summerwood, a gradual change from springwood to summerwood, a "dead" nonlustrous appearance, (apparently due to fibril angle differences) and usually, but not always, wide growth rings. No claim can be made that this visual method makes possible the recognition of core wood only, or of all the core wood present. But it appears that the visual separation coincides somewhat with the most rapid change of properties for both specific gravity and fiber length. The visual separation does make possible the use of predominantly outer wood in tree-to-tree comparisons, and thus makes possible the comparison of woods from trees of different ages, a comparison that is impossible if the core wood is included. It was the need for a reliable tree-to-tree comparison that prompted the present study. Therefore, this visual division makes possible an estimation of the wood property differences by the forest industries, although some wood technologists do not like this rough zoning of a tree's bole, since there is no actual definite zone, but a gradation from one zone to the other. Several researchers have objected to the visual separation and have suggested counting out from the pith a set number of growth rings. This technique would be satisfactory for a large number of trees where only a general average is desired. But it would be of little value for any individual tree, since the years of core wood formation greatly varies among individuals, even when grown under similar environmental consitions (see Fig. 3). A further, very complicating factor is that near the pith of both slash and loblolly pine it is often difficult, if not impossible, to accurately make a ring count because of false and indistinct rings. Thus, it seems best to make the separation into core and outer wood visually.

Core wood as such is not too important in timber grown under long rotations, since it constitutes only a small portion of the total volume of older trees. The lower the rotation, the more important it becomes, as previously shown (*56*). For example, one 18-yr.-old stand of loblolly pine contained 47% by volume core wood, while another stand on a similar site that was 48 yr. old had only 8% by volume of core wood.

However, core wood does become of vital importance under certain circumstances:

1. Those organizations that sell saw timber and use the top wood in the pulp mill get an excessive amount of core wood. With this core wood also goes a higher proportion of knot wood and compression wood, all of which have characteristics that are undesirable for most products. Also, according to Taras§§ (see also Lindgren (*29*) the top wood has a high moisture content, so if bought by weight, one obtains a lower specific gravity, less cellulose yields, more water, and more knot and compression wood.

2. Those organizations that are using young thinnings obtain an excessive amount of core wood since the young trees have not had time to produce much outer wood.

3. Sawing of lumber with core wood included invites troubles, since it dries differently from outer wood, having excessive longitudinal shrinkage and other differences.

4. Use of veneer cores for pulp chips results in almost complete core wood, with resultant low yields and different pulp strength properties.

5. Use of sawmill waste, especially slabs, results in chips consisting predominantly of outer wood. Such chips have very different fiber characteristics from chips from young thinnings. If both are pulped together, either one will be "over-cooked" or the other "under-cooked." Differences between core and outer wood from the same tree are often much greater than differences between outer woods from different trees.

How can this information be of use since one fact is evident, i.e., core wood is with us to stay? Under present forestry practices, there is no escape. The objective of this paper is to point out the properties, extent, and location of core wood. It is for others, such as the pulp industries, to determine its effects under commercial pulping procedures. If the differences are great, a series of pulp bolt grades, such as suggested by Bethel (*2*) as early as 1940, should be used. In fact, a few industries are now doing this.

Certainly the wood users should seek to understand the significance of core wood as it relates to procurement and fabrication of specific products. For example, what is the value of top wood? What will it produce in fiber yield and quality? How much can be paid for wood that has a high proportion of core wood, of compression wood, of knots, and runs heavy to moisture? The time may yet arrive when certain types of wood cannot be harvested and handled at a profit, even for pulp, the same as has come to pass for small-diameter logs in the lumber industry.

But if the wood buyer and user needs to concern himself about core wood, so also should the forester. How should the forester handle his forests for maximum fiber yields? What spacing is best? What rotation ages should be used? One thing seems clear: Volume production as such is only a portion of the answer. Quality of fiber and yield of fiber per unit weight of raw wood must also be considered. For example, there has been loose talk that two 15-yr. rotations which yield the same volume as one 30-yr. rotation are of equal value. They may well yield the same volume, but most certainly they will have a different fiber yield, fiber length, and cellulose yield. Both the forester and the mill personnel have a stake here. In addition, they need to look more closely at the cost of the manufactured product in relation to quality of the raw material. Does it cost the same in time, space, chemicals, and equipment to process two cookers of wood chips, one of which will yield a considerably greater weight of wood pulp and longer fibers than the other? Should not a value differential be established for the different types of wood that go into the cooker?

Core wood is wood produced nearest the pith and is thus physiologically young, or juvenile wood. The results obtained in this study show relatively uniform

§§ Personal communication, 1958.

specific gravity throughout the core, and results of other studies show that fiber length in core wood is also quite uniform, with difinitive properties that might be called juvenile. The mechanism, or reasons, for the production of a different, or juvenile, type of wood near the pith is still open to conjecture. All that is now known is that we have such core wood, and we have the problems associated with its properties. Since trees normally pass through a juvenile period of leaf formation, flower production, fruiting, etc., it is not so strange that this period is also encountered in the formation of wood, but with this basic difference, that once the elements have been laid down, age will do little to markedly alter the properties of the "young" wood.

## SUMMARY

Research is reported on characteristics of core wood, within a tree and among trees. This research was carried out in 1957 and 1958 in a six-state territory, mainly in the Carolinas and adjoining states. The general concept of core (juvenile) and outer (mature) wood is discussed and practical uses of the information on core wood are considered.

Based on an extensive study of 670 loblolly pines of varying ages, and an intensive study of 47 slash pines and 13 loblolly pines (nine trees age 17, four trees age 50), the core wood was found to have the following characteristics:

1. Core wood specific gravity tends to vary inversely with height in the tree to about 10 ft. from the base of the tree, then becomes relatively constant all the way to the 4-in. top. For practical purposes, core wood can be considered to have a uniform specific gravity within an individual tree. In marked contrast, the outer wood drops rapidly in specific gravity, with increasing height in the bole.

2. Core wood is considerably lower in specific gravity than mature wood of the same tree at any position up the tree. This difference becomes smaller toward top of the tree.

3. In young loblolly and slash pines there is a very close association between the specific gravity of core wood at breast height (4.5 ft.) and that of the entire zone of core wood ($r = 0.88$ for slash pine, $r = 0.77$ for loblolly pine). Similar close relationships exist between core wood specific gravity and the specific gravity of the total tree bole. It was found that, especially for specific gravity, the "predictive value" of core wood is high, either as an indicator of the values for the core wood of the whole tree, or for all the wood (core and outer) of the tree.

4. Cellulose yields showed the following trends: For slash pine WRC of core wood increased over 3% from breast height to tree top, while alpha-cellulose dropped very slightly from base to top of tree. Loblolly pine had a similar pattern, the WRC of the core wood increasing with height in the tree, while the alpha-cellulose remained nearly constant from base to top of the tree.

A discussion of the significance of pitch depositions and heartwood formation and their effects on specific gravity and cellulose yields is included. Considerations of the value and limitations of core wood are made in addition to discussions of the significance of this concept to forestry practices.

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# Sodium-Base Pulping and Recovery

ROBERT Q. BOYER

**An approach to soda-base recovery based on separation of cooking requirement of sodium carbonate from the smelt and recycle of the sulphide to the furnace is presented. The interrelation of pulping, washing, evaporation, burning, chemical conversion, and cooking liquor preparation are treated and described as the inseparable general problem of chemical recovery independent of the system employed. The known proposed recovery systems are categorized as hydrogen sulphide releasing, as direct oxidation, or as sulphide recycling based on the characteristic chemical conversion. A reaction between sulphide and the spent liquor can be used to simplify the evaporation problem.**

Our investigation of sodium-base recovery has led to what we feel is a new recovery concept. This concept may be characterized as the sulphide recycle. Its application is the basis of a new group of recovery processes.

The hitherto proposed recovery system falls into two groups. The first and largest have in common the fact that hydrogen sulphide is released from the mixture of sodium sulphide and sodium carbonate which constitute the ash from the burning of the soda base liquor. The second group have in common the fact that the sodium sulphide is oxidized directly to sodium sulphite. All of the recovery systems which we are discussing have in common the following unit processes: (see Fig. 1) (1) evaporation, (2) burning, (3) base recovery, (4) chemical conversion, (5) sulphur dioxide recovery, and (6) acid making.

In general, these recovery processes differ principally in the step of chemical conversion. The group of recovery processes which we are introducing here are based upon the fact that there exist several means for separating the sodium carbonate from the sulphide. The separated sodium carbonate is the base used in the recovery of the sulphur dioxide. It is then used in the preparation of the cooking liquor. The separated sulphide in some form of a sodium-sulphur compound (with the exception of sulphate), is by some path returned to the recovery furnace. Here it is at least partially converted to sodium carbonate and sulphur dioxide by chemical reactions within the furnace.

One might think of this process as a parallel to the magnesium-base recovery system wherein all of the sulphur destined for recovery is released into the boiler gases as sulphur dioxide and the base is simultaneously produced in the furnace. The magnesium-base recovery method has been named for the form in which the base is recovered. In other words, "the MgO recovery system." Because of the parallel mechanism we have proposed to term this, "The Soda Ash Recovery System" which identifies the form in which the base is recovered.

The sulphide recycle group have in common the return by a path, however torturous, of the smelt sulphur to the furnace. If the sulphur compound returned to the furnace did not form appreciable amounts of sodium carbonate, the sulphide in the recycle would build up a prohibitive degree. The facts are that the compound is converted in the furnace to a considerable amount of sodium carbonate. Indeed with the exception of sodium sulphate addition, the smelt sulphur does not rise much above an equimolar mixture of sodium sulphide and sodium carbonate or, as it is known in the kraft industry, a 50% sulphidity. The rule holds even though the ratio of sulphur to to sodium is quite high in the firing liquor.

The 50% rule has been established by the burning of all types of liquor by ourselves and others. The explanation seems to lie in the facts that:

1. The ratio of sodium to sulphur is established at the completion of the charring stage of the incineration.
2. The end products of the charring are sodium carbonate, sodium sulphate and carbon.

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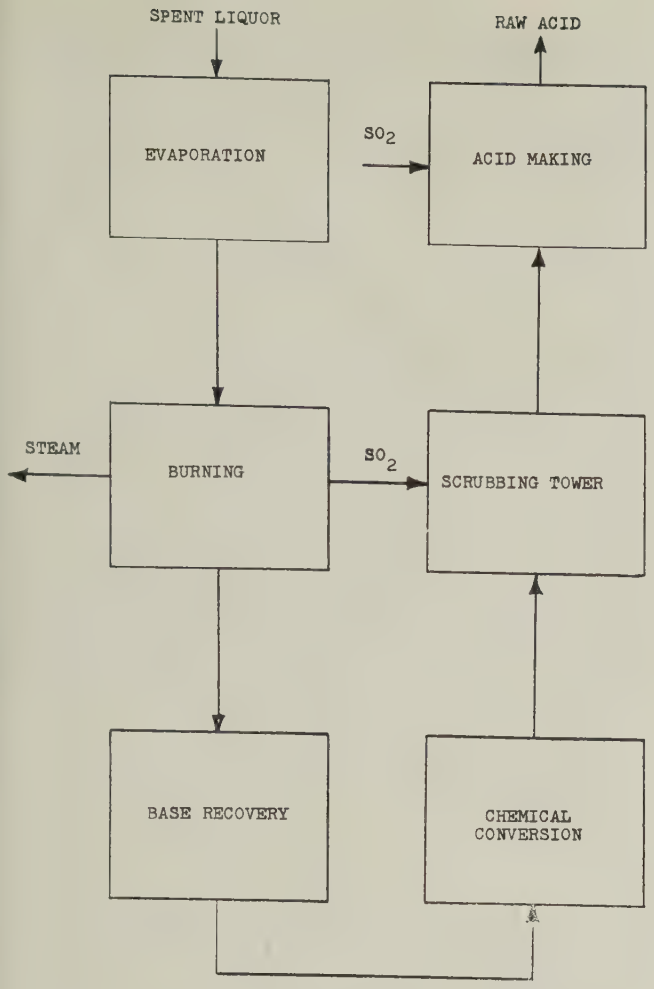


*Fig. 1. Fundamental acid sulphite recovery system*

3. The ratio of sodium to sulphur is not altered markedly during the smelting stage, wherein, the sodium sulphate is reduced to sulphide, residue carbon burned off and the mixture of the sodium carbonate and sodium sulphide melted.

Sodium sulphate present in the firing liquor goes through the charring stage unchanged. Sodium sulphide during the charring stage is apparently mostly converted to sodium carbonate. All of the sulphur organic compounds are partitioned by the 50% rule, giving mole for mole sodium carbonate and sodium sulphate and releasing the excess sulphur into the furnace gases.

Within reason the expected sulphidity can be predicted from the analysis of the liquor going into the furnace. The resulting sulphidity will be the moles of sodium as sulphate present plus one-half the difference of the total sodium and the sum of the sodium sulphate and sodium sulphide present, divided by the total number of moles of sodium present.

$$\frac{Na_2S}{Na_2CO_3 + Na_2S} = \frac{Na_1 + 0.5\,(Na_T - Na_1 - Na_2)}{Na_T}$$

where

$Na_1$ = moles $Na_2SO_4$.
$Na_2$ = moles $Na_2S$.
$Na_T$ = moles total sodium.

The ratio of sulphur dioxide in the gas at the stack to the total sodium to the furnace will be the mole ratio of sulphur to sodium in the liquor less the mole ratio of sulphur to sodium in the smelt, less one half the sodium in the volatilized fume.

$$\frac{SO_2}{Na_T} = R - 0.5\,\frac{Na_1 + 0.5\,(Na_T - Na_1 - Na_2)}{Na_T} - 0.5f$$

or if the $Na_2SO_4$ only source is the precipitator catch, then the equation reduces to

$$\frac{SO_2}{Na_T} = R - \frac{Na_1 + 0.25\,(Na_T - Na_1 - Na_2)}{Na_T}$$

where

$R$ = the ratio of sulphur to sodium in the firing liquor.
$f$ = fraction of total sodium volatilized.

It was stated that the sulphide recycle methods did not imply the release of hydrogen sulphide. Actually mixing sodium sulphide with the thick liquor before burning performs the chemical operation of releasing the hydrogen sulphide in the furnace. By feeding the sulfide into the furnace in the thick liquor, we avoid the danger inherent in the external handling of the lethal and explosive hydrogen sulphide gas.

Were there no other advantages to the sulphide recycle methods we feel that the direct recycle of sodium sulphide to the furnace—as a process—should merit serious consideration by the industry. This is so on the basis that the method accomplishes the following:

1. Elimination of the inherent operating danger of handling hydrogen sulphide gas.
2. Production of a high carbonate smelt suitable for use in the kraft process in combined kraft and sulphite mills.
3. Production of additional carbonate for use in the two-stage cooking methods such as are being practiced now in Finland.

Great advantage can be gained, however, by the sulphide recycle method if the sulphide to be recycled to the furnace is used to tie up all of the sulphite ion present in the spent liquor and all sulphite that can be dissociated from the lignosulfonates during the evaporation. This treatment gives a kraft-type liquor that can be handled in kraft evaporators.

Before discussing the details of this system we should analyze the problems of recovery. These are taken up in the order of importance: (1) the recovery boiler, (2) the evaporation system, and (3) the influence of recovery and pulping practice.

## THE ECONOMICS OF RECOVERY SYSTEMS

There are only three possible sources of income to defray the costs of installation of a recovery system: (1) pulping gains by the use of a soluble base, (2) the generation of steam in the combustion, and (3) the reduction in sulphur consumption.

The saving which might be effected in the replacement of limestone by the recoverable soluble base is usually more than offset by the losses of the more expensive sodium, so this is not considered a source of income. The largest single source of income, also the one with the highest costs, is the production of steam.

There is approximately 2600 lb. of solid per ton of pulp at 8000 B.t.u.'s per lb. or approximately 20,000 lb. of potential from and at steam which at the usual market is worth 60¢ a thousand in the header as superheated steam, or $12.00 worth of steam that could be produced. Eighty per cent collection drops this to 16,000 lb. of steam per ton at a value of $9.60 and considering an 82% efficiency of the boiler, drops the possible recovery of the steam to $7.90 and considering the fact that there is an evaporation of 1800 lb.

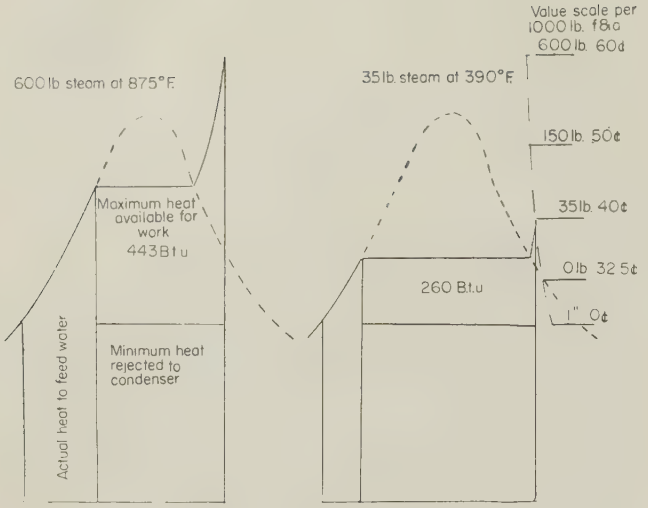
Value scale per 1000 lb. f&a
600 lb. 60¢
600 lb steam at 875°F
351b steam at 390°F
150 lb. 50¢
Maximum heat available for work 443 B.t.u
35 lb. 40¢
260 B.t.u
0 lb 32.5¢
1" 0¢
Actual heat to feed water
Minimum heat rejected to condenser

*Fig. 2. T-S diagram*

of water by either direct contact evaporator of the boiler or evaporated directly in the boiler furnace, this drops the value of the potential to $6.80 per ton.

The value of using soluble base is probably no more than $3.00 a ton. There is approximately 300 lb. of sulphur per ton of pulp. This has a market value of no more than $5.00 of which $3.00 is recoverable.

The value of steam becomes a determining factor in the justification of recovery systems. We should then elaborate on this critical subject.

At this point, we might divert and show a basic argument between the power engineer and the chemical engineer. This has to do, of course, with part of the recovery in which their interests cross—the value of the heat generated. It leads to some weird installations justified on the particular accounting system which exists at the mill.

The power department manufactures power from steam and other energy sources. In general, the power department produces the steam. However, the power department can manufacture this steam for say 60¢ a thousand f & a at the temperature and pressure of the main header. This steam is then dropped through their turbines and is delivered as process steam to the various departments at their required pressures. If the process steam is sold, as it usually is, to the various departments at the B.t.u. value including latent heat, the power department realizes considerable profit on this operation. Usually, however, they have to operate much of their generated capacity with condensers rejecting the latent heat to cooling water. Under these conditions the value of the electricity at the bus bars directly reflects the cost of steam.

A thermodynamic accounting system is needed. There is no simple thermodynamic bookkeeping formula. We would like to propose one which we believe is equitable. This bookkeeping follows the Rankine cycle but takes into account the stage heating of the boiler feedwater and might be called the regenerative formula.

The value of steam taken away from a turbine at any extraction point is by this formula: The maximum theoretical heat remaining available for work as valued at the throttle conditions plus the maximum heat available for stage feedwater heating priced at fuel value.

This regenerative cycle which any modern turbine approaches is discussed in any book on power engineering.

The remaining heat available for work can be computed from the steam tables:

$$Q_w = (h_2 - h_1) - T_c\,(S_2 - S_1)$$

Feedwater heating is found from:

$$Q_h = (h_1 - h_c)$$

where

$h_2$ = enthalpy of the steam at its conditions.
$h_1$ = enthalpy of water at the pressure of the extraction, and at the temperature of saturated steam.
$S_2$ = entropy of stream at the conditions of $h_2$.
$S_1$ = entropy of water at the conditions of $h_1$.
$T_c$ = temperature in degrees Rankine of saturated steam at the pressure of the condenser.
$h_c$ = enthalpy of water at temperature $T_c$.

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The discussion in this paper covers the majority of mills where power generation is a major factor. Part of sodium base recovery is the change in cooking practice from direct high pressure steam to indirect cooking with low-pressure steam heaters In mills not generating power, simpler recovery boilers operating at saturation are indicated in combination with back pressure forward feed evaporators. The low-pressure steam from the evaporators sent to the digester indirect heaters just balances the cooking steam requirement. The "Bradley process" of liquor fixing should make this scheme feasible in mild steel. The heat earnings of the recovery then become the entire steam production of the recovery boiler.

Example: 875°F. and 600 lb. gage.

| | |
|---|---|
| Value of header steam/lb. | 0.865 mils |
| Value of 1 lb. hot water | 0.198 mils |
| Value of 443 B.t.u.'s available for work | 0.667 mils |

$$\frac{0.667}{443} \times 1000 = 1.51 \text{ mils/1000 B.t.u. for } Q_w$$

Extraction at 390°F. and 35 lb. gage

$Q_w$ = 260 B.t.u./lb.
$Q_h$ = 203 B.t.u./lb.
$0.260 \times 1.51 = 0.393$ mils
$0.203 \times 0.45 = 0.095$ mils
0.488 mils/lb.

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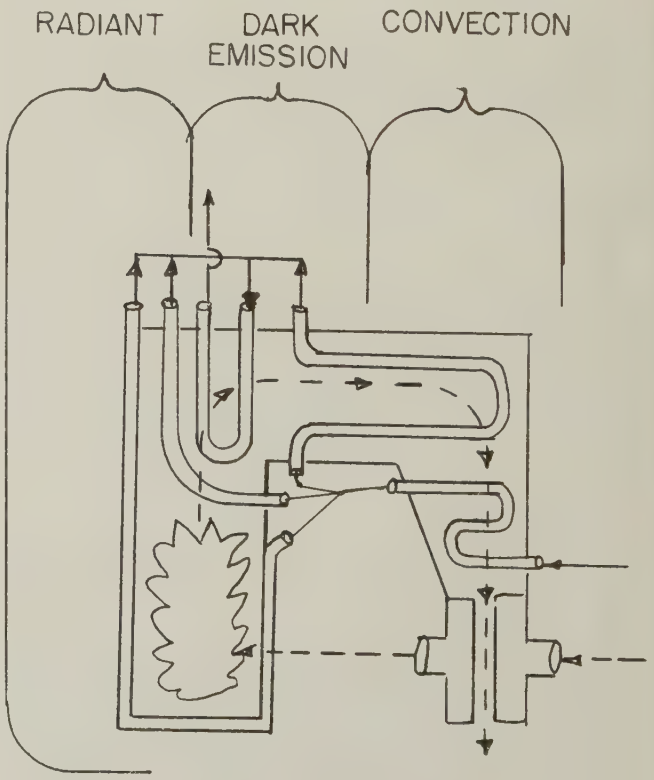


*Fig. 3. Model boiler*

The value of $Q_w$ on a heat unit basis is set by determining $Q_w$ and $Q_h$ of the steam in the header. From the total monetary value of a unit of steam, the monetary fuel value of $Q_h$ is subtracted. This then represents the value of the heat available for work. Dividing it by the heat available for work gives the value per heat unit of $Q_w$.

The cycle of the superheated steam and the steam extracted at 35 lb. gage, given in the example, are shown in Fig. 2. These are plotted on temperature entropy coordinates. The area enclosed in the section represents enthalpy. As is explained in any book on power engineering, these are mathematical rather than real cycles so should be considered rather area-comparison graphs. They give us a much clearer picture, however, of the use of steam in a power cycle.

A great deal of the justification of sodium base recovery lies in an understanding of the great investment necessary for a recovery boiler. This has led many people to the belief that they can utilize one of the plant boilers for say calcium base burning more advantageously. Figure 3 is a representation of a model boiler. It is broken down into sections according to the governing mechanism of heat transfer.

The furnace and screen tubes are controlled by radient emission.

$$Q = Ek\,(T_f^4 - T_s^4)$$

where

$E$ = area of the flame envelope.
$T_f$ = flame temperature in degrees Rankine.
$T_s$ = tube surface in in degrees Rankine.
$k$ = emissivity constant.

The super heater and part of the boiler is governed mainly by dark emission of $CO_2$ and $H_2O$ bands.

$$Q = Sk\,(\alpha T_g^4 - \gamma T_s^4)$$

where

$S$ = absorbing surface.
$T_g$ = temperature in degrees Rankine.
$k$, $\alpha$ and $\gamma$ = functions of the $CO_2$ and $H_2O$ content of the gas.

The rest of the boiler, economizer, and air heater are governed by convection heat transfer.

$$Q = Q_{\max.} \left(\frac{V}{V_1}\right)^{0.2} \frac{\Delta T_1}{\Delta T_2 + \Delta T_1} \left\{1 + \left[\frac{\Delta T_2}{\Delta T_1}\right]\left(\frac{V_1}{V}\right)^{0.4}\right\}$$

where

$Q_{\max.}$ = heat transferred at maximum steaming rate.
$V_1$ = volume of gas through the boiler at maximum steaming.
$V$ = volume of gas through the boiler at $Q$ conditions.
$T_2$ = temperature difference at the entrance of the section.
$T_1$ = temperature difference at the outlet of the section.

The convection section is remarkably stable to additions of water or other increases in volume. The dark heat transmission is actually increased by the addition of moisture. However, the radiant section where most of the steam rises is radically affected by the size of the flame envelope and the reduction in the flame temperature. The burning of a wet fuel in a separate burner and introducing it into such a furnace can easily reduce an expensive existing power boiler to the function of a waste heat boiler and reduce its maximum steaming rate by the ratio found in the difference in price between a recovery boiler and a power boiler.

The recovery furnace and boiler is a high-pressure steam generator and a chemical unit process at the same time. Its capital value, as a steam producer, should be equivalent to a fuel fired boiler of equal steaming rate. The additional cost of a recovery boiler should be a capital charge against chemical recovery. The same remarks should apply to operating costs, labor, and burden.

The model boiler formulation should help one in understanding the expense and value of a sodium-base recovery boiler and not be trapped into thinking that capital costs are reduced by using a regular power boiler for sulphite burning.

We can set forth a basic sodium-base recovery plant which can include for that matter, the kraft process.

The following arrangement, it is believed, can be justified even for the kraft process on the basis of efficiency and it will operate with any recovery system.

The first effect will be forced circulation stainless steel. Storage for the partially evaporated liquor will be provided between the first and second effects. The rest of the evaporators will be the sulphite or kraft type. The boiler will be the modern recovery boiler equipment with both an economizer and an air heater with an outlet temperature of 300°. The flue gases go directly through an electrical precipitator and then through an evaporative cooler operated on weak liquor, then scrubbed with a wetted wall-type tower, operated with a sulphite-bisulphite solution.

A total of four effects are justified in the cost of sulphite evaporators. In the cost of the kraft-type evaporators, a total of seven effects can be justified. This is established on the basis of the method explained by Coston and Lindsey (*1*). In addition, the kraft-type system will include the equipment necessary for converting the liquor. Both systems have nearly identical capital investment requirements, equipment costs being approximately $300,000 for a 200-ton mill, if selected according to the following discussion.

The comparable systems are:

Kraft Type
1 FC in stainless steel
6 LTV in mild steel
1 Thickener and air oxidizer

Sulphite Type
2 FC in stainless steel
1 settler between the FC for crystal circulation
2 LTV in all stainless

The sulphite-type evaporator is one constructed to handle a liquor corrosive both on the liquor and vapor side and to provide for the precipitation of calcium sulphite and calcium sulphate, both which tend to scale the heat transferring surfaces due to their decreasing solubility with increasing temperature. Typical solutions to this problem have been the switch-type evaporator, circulating magma type and regular evaporators of either forced or natural circulation with the provision for extra bodies to provide for boil-out. Typical liquors which have been handled in these machines are untreated calcium-base, magnesium-base, and ammonia-base acid sulphite, and the neutral sulphite semichemical.

Untreated sodium-base liquors, the same as other soluble base liquors, consist of approximately 10% of the base as calcium that is extracted from the wood. This calcium starts to come out as sulphite and sulphate

after the concentration in the evaporators has reached about 30% so that the top half of the group of evaporators must provide for the calcium scaling exactly as with calcium-base liquor.

The kraft-type evaporator handles spent liquors which are relatively noncorrosive, both on the liquor and vapor side and are nonscale forming. A typical liquor in the past, handled by this type of equipment, has been the partially desulphonated sulphite liquor from the Robson process, and of course, the kraft liquor.

Attempts to neutralize sulphite liquors to a high pH and then evaporate them have failed in the past except when the neutralized liquors have some sulphide present, or when the neutralization treatment has partially desulfonated the liquor. This has been due to vapor side corrosion.

Based on our studies in which we compared the vapors from neutralized sulphite and from kraft liquor, the following evidence indicates a mechanism of this corrosion:

1. Organic acids volatilize from both liquors in approximately the same quantity giving de-entrained condensates a pH of between 4.6 and 5.

2. In the absence of an oxidizing agent, i.e., $O_2$ or $SO_3^=$ ion, hydrogen ion will not attack mild steel at a pH of 4.5.

3. In the absence of hydrogen sulphide the entrainment from neutralized sulphite liquors has considerable sulphite ion. The entrainment comes over as a sulphite ion bearing mist which is incorporated into the condensates on the condensing surfaces of the vapor side of the next effect. As the sulphite industry knows, sulphite ion, at a pH of 4.5 and 5 reacts vigorously with mild steel.

4. In the presence of acid, hydrogen sulphide reacts with the sulphite ion to form sulphur, thus, destroying the corrosive sulphite ion present from the entrainment.

5. The entrainment from partially desulphonated liquors contains only minute amounts of sulphite ion and is therefore innocuous. Sulphur in the entrainment in the form of thiosulphate is innocuous.

6. Hydrogen sulphide or sulphide ion in the entrainment will not attack iron except in the presence of oxygen wherein it forms an iron sulphide scale in the vapor side.

The question arises why not add sodium sulphide to neutralize the sulphite liquor. This solution to the problem has the complication that even at a pH of over 10, 60% of the sulphide ion is volatilized into the vapors during the evaporation of a mixture of sodium sulphide and sulphite spent liquor.

The major difference between the two systems is the continuing costs. In each case, the evaporators will have to evaporate approximately 14,000 lb. of water per ton of pulp produced. In one case the economy is 3.2 or a steam consumption of 4380 lb. plus approximately $1.00 per hr. for FC electricity and in the other case, the economy will be 5.6 and the steam consumption will be 2500 lb. plus approximately 50¢ per hr. for FC electricity.

Our studies have lead us to believe that stainless steel washers are difficult to justify except for pollution abatement. We feel that with careful operation, an 80% collection can be made at 12½% solids, with blow pits.

A major problem of recovery is the water load into the evaporator and the heat economy of the evaporation and burning system. Without taking advantage of every means of minimizing this expenditure, the entire concept of recovery may become prohibitive. For this reason, the cooking liquor preparation, the operation of the digester and the collection of the liquor, are the most important factors in creating an economic recovery system and inseparable from it.

The kraft industry of necessity, long ago, learned to operate their entire pulp production so as to minimize the amount of water which would have to be handled in evaporation and burning. The sulphite industries can learn much from the kraft industries developments, but has at hand certain other factors which it may utilize to solve this problem.

The sulphite man will have to develop a recycle of part of the solids to the digester which will fit the peculiarities of his pulping.

## CHEMICAL CONVERSION

Chemical conversion is the formation of the smelt sodium combined with sulphide into a sodium sulphite compound. All systems are characterized by this recovery function. The generic families are (1) direct oxidation, (2) hydrogen sulphide release, and (3) sulphide recycle.

Direct oxidation methods depend upon the controlled oxidation of the sulphide sulphur of the smelt to produce an impure sodium sulphite. Simultaneous decomposition of sodium sulphite dictates a need for extremely rapid oxidation. The rapid oxidation is achieved by presenting a large surface during treatment. The impure product may be purified by a sulphiting leach.

Hydrogen sulphide release methods depend upon a source of hydrogen ion to replace the sodium. In the recovery system, there are at least six sources of hydrogen ion. There are at least three methods of applying the hydrogen ion to the green liquor and at least three ways of disposing of the hydrogen sulphide released so that if anyone wishes to, they may compute the combinations. There are sure to be more hydrogen sulphide methods invented—the first one having made its appearance in the late 1890's.

The sulphide recycle methods are still being developed by ourselves. We have stated that one type of sulphide recycle method can be used to produce liquor that can be handled in the kraft-type evaporating system. The problem as we have stated is to react the sulphide separated from the smelt with the spent liquor. The solution to this problem constitutes the Bradley process.

At the usual temperatures found in the mill, a mixture of spent liquor and sodium sulphide at a high pH does not react the sulphide and sulphite ion present. Some desulphonation, however, takes place due to the presence of hydroxide ions. However, Bradley and Boyer investigated means of causing this sulphide-sulphite reaction.

From the chemist's point of view, the reaction was thermodynamically favorable. The reaction apparently goes step-wise through several steps. The first step is the oxidation of sulphide to a higher valence.

It has been fairly well established that the oxidation of the sulphide was the rate determining step. The last step which is the addition reaction of sulphur to the sulphite ion to form thiosulphate, was found to be rapid. The oxidation of the sulphide by sulphite through the rate determining step could be made to go rapidly with sulphite ion at 300°F. and corresponding pressure. The same result was achieved by blowing the mixture with a limited amount of air to take the sulphide to the zero valence state.

Properly reacted, the sulphite ion that can be rapidly dissociated from the lignosulphonate and the other sulphite addition compounds present is all reacted to form thiosulphate ion in solution. This consumes all of the sulphide present. Therefore, the liquor has mainly thiosulphate ion present. The partially desulphonated lignin present has similar characteristics to kraft lignin, i.e., it is acid precipitable. On prolonged standing the partially desulphonated lignin will give up further sulphite ion so that it is necessary to provide for this in storage.

The reaction can be driven to completion so that the very slow dissociation of the tightly bound lignosulphonate is completed, but it is not necessary to do this in order to get a satisfactory evaporator operation. The result of the partial reaction gives a liquor with the following properties (1) free of calcium ion, (2) free of sulphite ion, (3) has a great pH enough to prevent organic precipitation in the evaporators, and (4) will not give off appreciable hydrogen sulphide during the evaporation.

The liquor acts in the evaporators like an air oxidized kraft liquor and indeed contains similar chemical compounds.


## SUMMARY

In selecting material for this paper, much editing had to be done. A complete paper on our justification for the assumption that you may obtain 12½% liquor at 80% collection with blowpits, of necessity, was deleted. Yet we labored, the recovery boiler and the evaporation system—this was namely because they are the principal investment charges. Unless you can justify them and think clearly upon their significance, no recovery system is economically feasible except under the pressure of the public for pollution abatement.

The selection of a conversion system may be somewhat a matter of taste. The main reason we have worked and will continue to work upon the sulphide recycle method, using the Bradley process, is that it offers the greatest flexibility for the future. It is the one system which can act for simultaneous recovery of kraft NSSC and acid sulphite. So far as we know, it has the lowest operation cost of any system on the same boiler arrangement. We outlined what we considered the best boiler arrangement in our discussion for a basic sodium-base recovery plant. Much of the apparent difference in operating cost can be attributed to the proposed method of boiler operation. This system can be applied to any such operation but as we have tried to demonstrate, the major source of income should not be sacrificed for an apparent gain in capital investment savings.


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# Controls and Instrumentation for Boilers Designed for Multiple Fuel Firing


CLAYTON H. BARNARD



**The ever increasing cost of fuel, together with improved equipment for the utilization of waste materials as fuels, has led to boiler furnace and auxiliary designs capable of burning several fuels simultaneously. This trend has resulted in the development of automatic control systems capable of meeting steam demands with full use of waste materials, and with the most economic use of other fuels. Controls for these services are called upon to perform many functions not required in a conventional single fuel boiler, such as selection of least costly fuel, and maximum use of waste fuel, at the same time keeping individual burners within safe operating limits. The paper outlines the fundamental requirements and the application of essentially standard control devices. Unsolved problems are discussed and suggestions made for modified plant designs more suitable for good control.**


Boilers designed for use with two or more fuels are increasing in number. Some of the major reasons for this are:


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1. To become independent of a single supply source.
2. To utilize the cheapest fuel available at any particular time.
3. To utilize low cost fuels which may be available from self-generated or purchased sources.
4. To utilize thermal energy available in waste products.
5. To make a by-product extraction process economical.

1. A plant designed for use with a single fuel can be occasionally shut down by an interruption in the source of supply. This interruption may be the result of strikes in a particular industry, inclement weather which seriously affects transportation, and in the case of gaseous fuels transported by long-distance pipe lines, major breaks in the lines which may take several days to repair. Thus, a single fuel which may be the most economical a major portion of the time, becomes exceedingly expensive when it is not available, due to the loss of production experienced. The last decade has seen a number of periods when a second source of fuel was the only means of maintaining production.

2. The use of the most economical fuel at any one

time permits the lowest cost operation for a maximum of production, essential for profit making in these times of severe competition. The supplier of one fuel is reluctant to raise his price if he knows that the plant can burn another fuel priced approximately the same which does not increase in cost, and thus the plant owner is able to keep his fuel cost at a minimum by competition between two or more suppliers of different types of fuel. In many areas of the country, seasonal prices of fuels may vary which makes one fuel more economical in the summer, and another more economical in the winter. Plants capable of taking advantage of this fact can select the most economical fuel at any time, and operate with a minimum year round cost. Many of the gas transmission companies will supply gas at reduced rates during the off-peak summer season, in order to maintain a more uniform load factor on the pipe line, with the result that plants in many areas of the country find it more economical to use a predominance of gaseous fuel in the summer months, and liquid or solid fuels in the winter months.

3. More and more, low cost fuels are becoming available from self-generated or purchased sources, and while oftentimes these are not sufficient for full production, they are used in combination with fuels purchased from normal sources with a considerable over-all saving. The sources of some of the low cost fuels available will be covered below.

4. The utilization of the thermal energy inherent in many waste products provides a low cost fuel for steam generation, even though the quantity may not be sufficient for full production, and requires a supplementary fuel at a somewhat higher cost. The rather large quantities of bark available in any pulp mill is a good example of such a waste fuel, and others will be discussed below.

5. In a number of industries, an extraction process utilized for the production of a particular product may not be economical in itself unless the by-products can be utilized in order to make the over-all process economical. There are many examples of this in many industries, one being the widespread use of black liquor recovery boilers in the pulp and paper industry. It is questionable if this process would be economical without the low cost steam made available for power and processing by the recovery process.

## FACTORS AFFECTING THE SELECTION AND USE OF MULTIPLE FUELS

Many factors may dictate the selection and use of multiple fuels for any particular installation. Some of the major factors are:

1. Geographical location.
2. Transportation and storage problems.
3. Availability of low cost fuels.
4. Availability of waste materials which can be used for fuel.
5. Type of product produced.

1. Basic fuel costs vary in different parts of the country, largely because of transportation costs. As new transportation facilities are designed and placed into operation, continual changes are taking place in the cost of fuel, and those plants equipped to burn multiple fuels are in a position to take advantage of these changes. For example, about 20 years ago, coal was by far the lowest cost fuel in New England, being mined in Virginia with relatively low cost labor and transported by seagoing colliers to New England ports. As the cost of mine labor increased, and the quality of coals decreased requiring more expensive cleaning methods, residual fuel oils transported by barge to New England ports resulted in liquid fuels being generally less expensive than coal. This prompted the coal suppliers to install mechanized handling devices which once again brought the delivered price of solid fuels down, and for several years coal and oil alternated in being the lower cost fuel.

More recently, natural gas pipe lines have been extended into many areas of New England, and at least during off-peak periods, provide natural gas at a cost slightly lower than either coal or oil. Thus, many plants burning any one or a combination of the three fuels can take advantage of the price structure at any particular time in order to get minimum production cost.

Similar patterns have been, and are being, experienced in many parts of the country, and it is anticipated that this trend will continue.

2 Generally speaking, solid fuels are transported by rail or by water when possible, and only recently have experiments started on other means which may result in lower transportation costs for solid fuels. Labor and transportation problems have many times interfered with the continuous supply of solid fuels and prudent operators have maintained an inventory to protect them in long periods of interrupted deliveries. This requires a considerable investment in the fuel itself, and in the land and handling facilities required. Oil is now transported largely by water transportation or pipe line for the longer distances, and by the tank trucks for the shorter distances. Again, interruptions in supply are not uncommon, and tank farms, involving both a capital and operating expense, are required as insurance against interrupted deliveries. Gas is normally transported by pipe lines, which in the last decade have reached a high degree of economy and reliability, but an adequate reserve supply in storage has yet to be worked out on a truly economic basis. Consequently, the selection of the proper combination of purchased fuels, which will involve the lowest operating cost and at the same time a minimum of capital investment and handling cost poses a complex problem.

3. Low cost fuels are many times available, either purchased or self-generated, although frequently not in the amounts required for full production, and seldom at a rate commensurate with plant requirements. However, because of their low cost, they can be utilized to the maximum extent possible, being supplemented by the more common fuels available. Many times, a neighboring plant has a surplus of low cost fuel which can be provided with an ultimate gain to both plants.

4. Where waste materials, which contain considerable amounts of thermal energy, are available they can be used in conjunction with conventional fuels at a minimum of over-all cost. These factors must be carefully evaluated on a continuing basis if steam and power generation is to be achieved at a minimum of cost. In industries where the steam and power costs are a high percentage of production cost, this becomes particularly important.

## TYPES OF WASTE AND LOW COST FUELS

There are many industries which have waste and low

cost fuels available, either for their own consumption or for sale at low cost to neighboring plants. All of these sources would be an exhaustive study in itself, and only the more common and well-known sources will be discussed.

Petroleum and chemical processing plants frequently have by-products whose prime value is in the thermal energy they contain. As new uses are found for various products, and new processes added, this availability is decreasing, but many plants still have substantial quantities available.

Refinery gas, frequently with high heating value, is available in some quantities from nearly every refinery, and carbon monoxide in substantial quantities is available in refineries operating catalytic units. Refinery gas is oftentimes available for sale to neighboring plants, although some refineries are equipped to burn all that is available, and in some instances have supplemented their fuel requirements with coal in areas where it is low cost.

The refining industry is now utilizing such a high percentage of its crude oil in salable products that not much is left over for sale as low cost fuel. Residual oils and refinery coke are not today readily available for purchase. Many petrochemical plants, on the other, hand, still have substantial quantities of residual materials available for sale, since their production is in excess of their own requirements.

Steel and coke oven plants have been another source of low cost fuel through their generation of blast furnace gas, coke oven gas, and a residue product known as pitch. In a number of areas in the country, blast furnace gas and coke oven gas are available from steel plants at relatively low cost. However, improved operation within the plants is reducing the availability of this fuel for purchase by others.

When not too much is left for sale, the utilization within the plants themselves contributes greatly to the economic operation of the plant and permits the purchase of a lesser amount of fuel in order to provide minimum over-all operating cost.

Waste and low cost solid fuels are many times available from various vegetable sources, and the utilization of bark as a heat source is well known in the paper industry.

Other sources of low cost fuel includes waste wood from the lumber and furniture industries, corn cobs and peanut shells from the processing plants, Bagasse which is residue of sugar cane after the juices have been extracted, and many others.

The price of instant coffee is held more nearly in line with the price of ground coffee by the utilization of the coffee grounds as a source of fuel to provide steam for the processing of the instant coffee.

## CONTROL REQUIREMENTS

In any combustion control system, irrespective of the type of fuel being used, the basic requirements are: (1) to maintain a constant steam pressure and (2) to maintain peak efficiency through control of fuel-air ratio.

In any given plant, there are other factors which must be controlled such as draft within the furnace, but these contribute to satisfying the basic requirements, and not supplement them.

In the case of multiple fuels, added requirements are frequently encountered:

1. Maximum utilization of waste fuel.
2. Use of the cheapest fuel combination.
3. Limit the ranges of the burning equipment for any particular fuel.

1. Where waste fuels are available, they should be utilized to the fullest extent since they are the lowest cost of all. In most instances, this can and should be done automatically.

2. The utilization of the cheapest fuel usually involves computations resulting in manual adjustments to the control system by the operator. Use of newer computer techniques can make this an entirely automatic function, but only the very largest plants can justify the expenditure for costly equipment of this type at the present time.

3. Where waste or low cost fuels are available in varying quantities, bearing no relation to the demand for steam generation, it is frequently necessary to limit its use for short periods in order to keep the burners handling the supplementary fuel within a reasonable operating range. Generally, this is done automatically.

## TYPICAL ARRANGEMENTS

(For the sake of simplicity and ease of understanding, the diagrams presented have been simplified by the elimination of hand-automatic selector stations, minor manual adjustments, controls for duplicate and secondary auxiliary equipment, etc.)

A basic control arrangement is illustrated by Fig. 1. The steam pressure acts through a pressure controller to regulate both air flow and fuel flow to the furnace, with fuel flow and air flow measurements acting through a ratio controller to readjust the fuel flow to maintain peak efficiency. While a particular plant design may dictate certain modifications to this general arrangement, it is generally basic to combustion control systems, irrespective of the type or combination of fuels.

A typical control arrangement for gas and pulverized

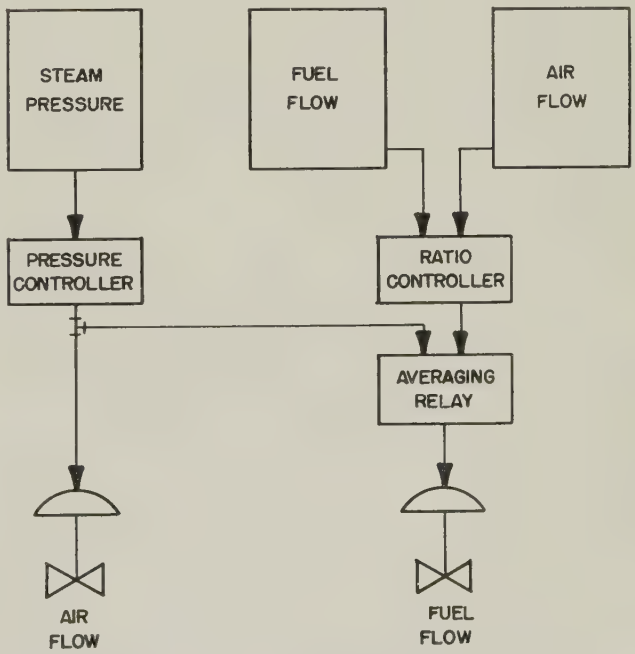


*Fig. 1. Basic combustion control system*

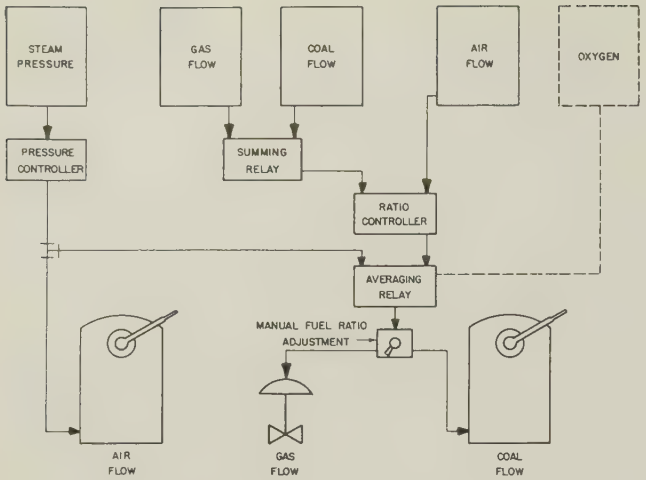


*Fig. 2. Control system and instruments for gas and pulverized coal firing*

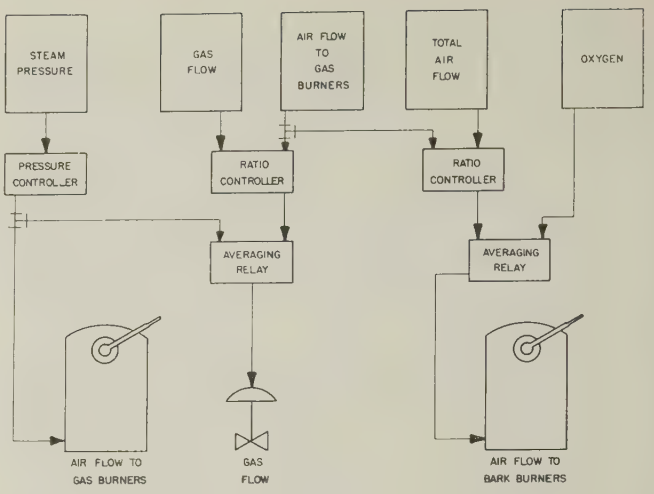


*Fig. 4. Control system and instruments for bark and gas firing*

coal firing is illustrated by Fig. 2. As in the basic system, steam pressure acts through a pressure controller to regulate air flow and fuel flow (both gas and coal) in parallel. Gas flow and coal flow measurements are combined in a summing relay, calibrated to take into account the heating value of the two fuels, and combined with a signal from the air flow meter, in the ratio controller, to readjust the fuel flow for maximum economy. A manual fuel ratio adjustment is provided in this typical example to permit selection of the most economical combination of fuels.

Since coal flow in particular is difficult to measure on a continuous basis with a high degree of accuracy, a measurement of oxygen in the flue gases is frequently utilized as a final readjustment for fuel-air ratio control. This system is typical of plants utilizing purchased gas and coal, where availability and cost dictates the fuel to be utilized.

Another typical system for gas and pulverized coal firing is illustrated by Fig. 3. In this case, gas is employed to the maximum limit of its availability, assuming that coal at a higher cost must be used as a supplementary fuel.

Again, the steam pressure acts through the pressure controller to regulate air flow and fuel flow in parallel. Gas is allowed to flow uncontrolled to the furnace except for the limiting action provided. Gas supply line pressure is used as an index of availability, and a low gas pressure acts through the limiting relay to reduce the gas flow. Since most coal burners have a limited range of operation, the control signal to the coal flow controller also reduces the gas flow when the coal flow to the burners approaches a minimum stable firing rate.

A measurement of gas flow and coal flow is combined in the summing relay on a total heat basis, and the signal combined with that from the air flow measurement to readjust the coal flow in order to maintain the proper fuel-air ratio.

The signal from the steam pressure controller is proportional to total heat requirements and the heat provided by the waste gas is deducted from the total requirement in the subtracting relay, the output signal of which is proportional to the required coal flow. Once again, an oxygen measurement is frequently employed as a final fuel-air ratio adjustment.

This system automatically uses the maximum amount of gas available, consistent with stable coal burner operation.

Of more particular significance to the pulp and paper industry is the typical system for bark and gas firing illustrated by Fig. 4. In this case, the bark is burned on one of the several grate arrangements commonly used, and separate combustion air ducts are provided for the gas burners. The bark is assumed to be admitted in a manually controlled manner to the grate, the gas being automatically controlled as the supplementary fuel.

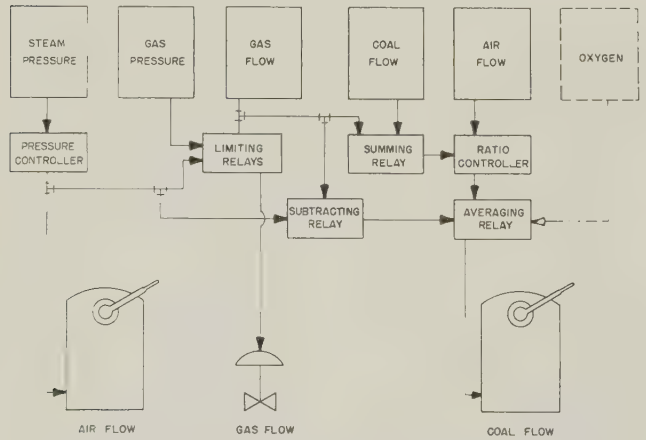


*Fig. 3. Control system and instruments for utilizing waste or low-cost gas in conjunction with pulverized coal*

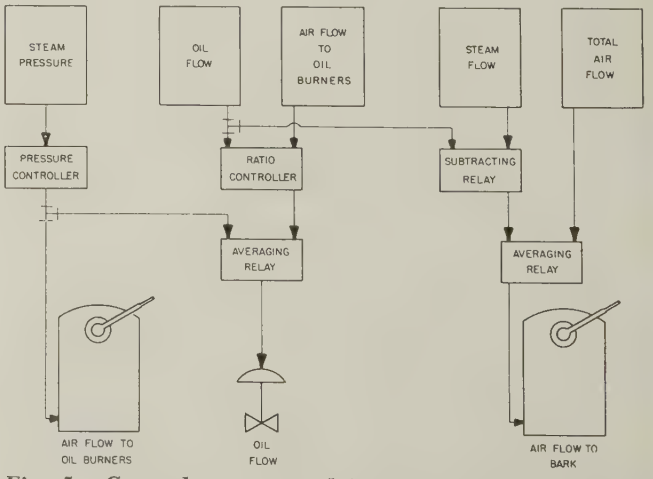


*Fig. 5. Control system and instruments for bark and oil firing*

Steam pressure acts through a pressure controller to regulate air flow to the gas burners and gas flow in parallel, with gas-air flow adjustment being made through the ratio controller to the gas flow control. The air flow to the gas burners is deducted from the total air flow, through the ratio controller to regulate the air to the bark burners, with the final adjustment being made from an oxygen measurement in the flue gases. The oxygen measurement is usually essential with this type of system in order to provide optimum fuel-air ratio.

A typical control system for oil and bark firing is illustrated by Fig. 5. This system is very similar to that shown for gas and bark with the steam pressure controller regulating the air flow to the oil burners and the oil flow in parallel with readjustment from oil flow-air flow to maintain proper combustion.

In this particular case, a steam flow measurement is used as a total demand signal, from which the steam generated by oil is deducted in the subtracting relay, the output of which regulates the air flow to the bark grate. Where the moisture content of the bark is essentially constant, the steam flow-air flow relationship is accurate for the control of fuel-air ratio. Where the moisture content of the bark varies considerably, an oxygen measurement as illustrated previously is superior.

A typical control system for coal and bark firing on a spreader stoker is illustrated by Fig. 6. It is assumed that the bark is admitted in a manually controlled fashion depending upon availability.

The steam pressure controller regulates the coal flow and air flow in parallel, with a steam flow-air flow ratio controller providing the necessary correction to air flow for proper fuel-air ratio control. The correction is made to the air, rather than the fuel in this instance, since heat release from stoker firing is more responsive to air flow than fuel flow. Again, if the bark is of widely varying moisture content, an oxygen correction will provide for increased accuracy.

Another combination being utilized to a considerable extent in the larger units is a furnace designed for burning pulverized coal and bark. A typical control system for this combination is illustrated in Fig. 7.

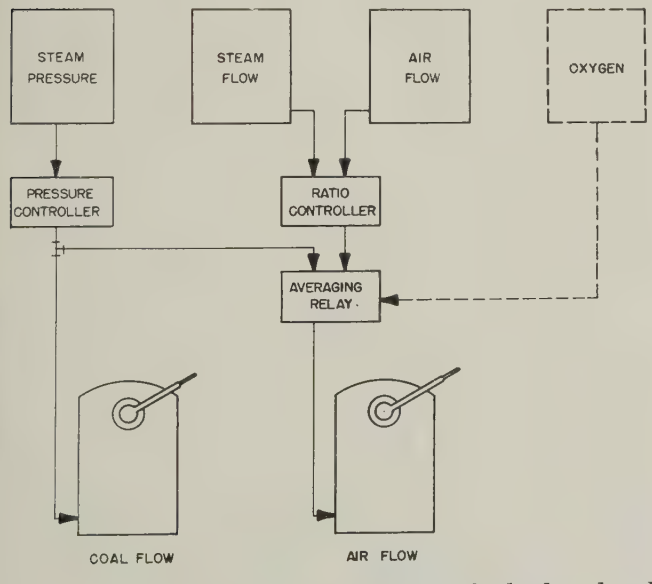


*Fig. 6. Control system and instruments for bark and coal firing on a spreader stoker*

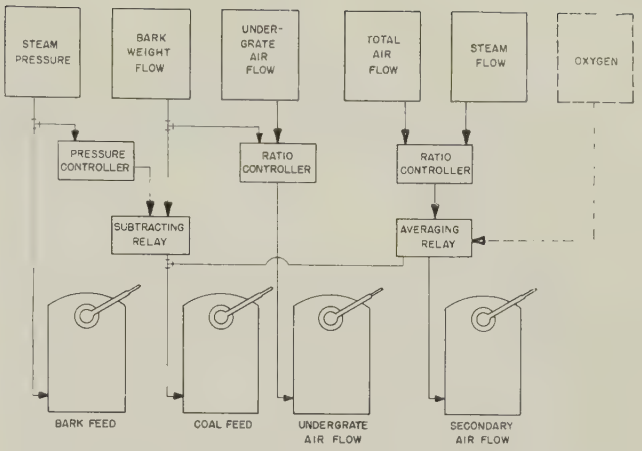


*Fig. 7. Control system and instruments for bark and pulverized coal firing*

In this arrangement, the steam pressure controller regulates the bark feed and coal feed in parallel, and provides a signal to regulate secondary air flow, which is readjusted by total air flow-steam flow ratio. An oxygen measurement may again be required for highest accuracy.

A bark weight flow measurement is introduced into this system to provide a signal to be used with a measurement of undergrate air flow for regulation of undergrate air flow in order to maintain the proper bark-air ratio. The heat released by the combustion of the bark is subtracted from the total heat required, in the subtracting relay, in order to provide the proper signal to the coal feed controller.

It will be noted that all of these systems permit maximum utilization of bark with only the remainder of the heat requirements coming from the higher cost purchased fuel.

Many combinations of fuels, either prime or waste, may be utilized, and in nearly every instance standard control and instrument components are available for assembly into systems similar to those shown. These do not have to be limited to two fuels, and in many instances involve three, four, or more.

It is the responsibility of the control supplier to provide the necessary measurements and control devices to meet the requirements of the individual plant, whether they be economic or technical. Manufacturers of instruments and controls are continually striving to supply better and more accurate devices to improve plant performance.

Because of the wide variety of experience available to manufacturers of control equipment, they are in a position to assist designers and operators of power boilers to get the most for their dollar in the production of steam and power. Many times, a particular arrangement of auxiliary equipment can simplify the control system by making available more adequate means of measurement and control, and close cooperation between designers and control manufacturers can keep the over-all capital cost of a plant at a minimum.

The trend to multiple fuels is certain to continue in the coming years and the manufacturers of plant equipment, designers, and operators must work together if the ultimate is to be achieved.

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# Viscose Pulps from Sugar Cane Bagasse

D. N. MITRA

**In an attempt to prepare viscous grade dissolving pulp from sugar cane bagasse, pulps from depithed bagasse were produced with relative ease by the sulphate process, but they were universally high in pentosan content. The pentosans could not be reduced by varying the cooking time nor by varying the cooking temperature, at least over the range investigated. A two-stage process, involving acid prehydrolysis followed by sulphate digestion was found to be highly effective in facilitating the removal of the pentosans to the desired level. In the acid prehydrolysis stage, the effect of certain variables was studied and the optimum conditions for both acid hydrolysis and sulphate digestion determined. Pulp produced in this manner, after bleaching by orthodox methods, gave a product which compared favorably with commercial viscose pulps. Xanthation of this pulp resulted in a clear viscose solution of low turbidity. Commercial feasibility of the process and the recovery of furfural as by-product are also discussed.**

During recent years, as a result of the tremendous increase in the consumption of pulp and paper and the resultant drain on the world's pulpwood resources, there has been a great amount of effort expended towards development of new sources of fibrous raw materials. These very large but comparatively untapped reservoirs of fibrous materials are being studied extensively and many commercial ventures in this field are going forward.

Until recently, cotton and coniforous wood were the principal raw materials for the manufacture of rayon pulps as they gave products of very high degree of purity suitable for chemical conversion. But as the world shortage of pulpwood became apparent, countries with limited resources of softwood turned to the use of various hardwoods and agrictultural residues as substitutes.

The use of bagasse as a possible raw material for pulp and paper manufacture has received much publicity during the last 50 years and a tremendous amount of experimental work has been carried out in this direction leading to different processes and products. Some of these processes include the Celdecor-Pomilio, mechano-chemical, Morley, Marsoni, etc., in addition to the conventional soda, sulphate, and acid bisulphite processes.

Bagasse has now been firmly established as a useful papermaking raw material but its suitability for rayon pulps has not been studied extensively and very little information has yet been published on this subject, although reference to literature (*1*) showed that several workers in the past had indicated this possibility. One of the major problems in the use of these hardwoods and agricultural residues for rayon pulps was their high pentosan content which was not easily removed during normal alkaline digestion. These pentosans consumed an excessive amount of chemicals in the derivative preparation and tended to cause the ultimate product to be unstable, yielding a solution of poor filtering properties and filaments of reduced tenacity. Another serious drawback, particularly with agricultural wastes, was the high content of inorganic substances, chiefly silica, which was detrimental to the final rayon pulps. The problem was thus to apply a process to these materials whereby pulps with reasonably low pentosan and ash and high alpha-cellulose could be obtained suitable for chemical conversion. Since, owing to high silica content, sulphite digestion with calcium as a base could not be employed, the only possibility was to modify the alkaline process. Moreover, as these materials generally contain a higher proportion of fats and waxes than softwood, an alkaline rather than an acid process was preferable.

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## APPLICATION OF VARIOUS TREATMENTS TO HARDWOODS AND AGRICULTURAL RESIDUES

One of the first investigators to use precooking treatments for the production of high alpha-cellulose pulp from hardwoods was Richter (*2*). Hardwoods, birch and maple, were first cooked in water at elevated temperature and pressure and then given a typical sulphate pulping treatment with liquor consisting of sodium hydroxide and sodium sulphide. During the high temperature water treatment certain organic acids were liberated from the wood which acted upon the pentosans in such a manner that they became soluble in the following alkaline cook. In another process, the wood chips were treated with mineral acid solutions at high temperature and pressure up to a period of 3 hr., after which the treated chips were given a typical sulphate cook.

Many other investigators, Jayme and Schorning (*3*), Correns and Schorning (4), Cornell and Montonna (*5*) also reported that pretreating hardwoods rich in pentosans with mineral acids under various conditions of time, temperature and pressure, made it possible to manufacture pulps by the sulphate process, which was low in pentosan and suitable for conversion to cellulose derivatives. In one case, Jayme (*6*) digested beech wood chips with 20% $H_2SO_4$ at temperature ranging from 70 to 80°C. for 2 hr., followed by a sulphate cook in which the liquor to fiber ratio was 4.75 : 1 and chemical concentration 3% sodium, distributed as 80% NaOH, 5% $Na_2CO_3$, and 15% $Na_2S$. The maximum cooking temperature was 170 to 180°C., depending on whether 70 or 80°C. had been used in acid treatment. The total digestion time was 5.5 hr., including 1.5 hr. to raise to maximum temperature and 1 hr. for relieving. Pulps in yields of 32 to 34%, containing 91 to 92% alpha-cellulose and pentosan in amounts less than 5% were consistently obtained. These pulps were easily bleached by conventional bleaching methods to high brightness and found to give good viscose solutions.

Jayme and Schenck (*7*) used the above procedure to manufacture rayon pulps from cereal straws. Wheat straw with an ash content of up to 9% was used in the experiments. Prehydrolysis was carried out with 20% $H_2SO_4$ at a temperature of 88°C. for a period of 20 to 30 min., followed by pulping with sulphate cooking liquor at a liquor to fiber ratio of 7:1 and chemical concentration of 3% sodium, distributed as 65% NaOH, 20% $Na_2CO_3$, and 15% $Na_2S$. The maximum cooking temperature was 160°C., the total digestion time 5.5 hr., including 1.5 hr. to raise to maximum temperature and 1 hr. for relieving. Bleached pulps in yields of 26 to 27%, containing up to 95% alpha-cellulose and pentosan in amounts varying from 4 to 7% were obtained. The ash content of this pulp at 0.44% was higher than that normally postulated for spruce sulphite rayon pulps, but it was claimed that a further reduction in ash would occur on a commercial scale.

According to Richter (*8*, *9*) the elimination of these pentosans from sulphate pulps, prepared from cellulosic raw materials rich in pentosan, can also be brought about by means of a chemical refining process, involving the use of different reagents. Pulp extractions with dilute sodium hydroxide at elevated temperatures or extraction with concentrated solutions at low temperatures gave desired results. It was also found that prehydrolysis with hot chlorine water, mineral acids, or other oxidizing agents followed by caustic extraction did the work.

Instead of using fairly high concentration of acid for prehydrolysis, diluted acid under pressure could be utilised for selective removal of pentosans. The Phrix-Werke AG Co. in Germany (*10*) developed a procedure whereby diluted sulphuric acid was used under pressure, the acid concentration and temperature depending on the type of raw material. According to this process the best results are obtained with 0.5 to 1% acid concentration at temperatures between 120 and 140°C. The yields of pulp varied considerably, birch 23%, beech 28%, aspen 29%, pine 34%, and straw 24%, the alpha-cellulose content ranging from 94 to 97%.

Other investigators, Door (*11*) and Schultz and Sarten (*12*) also pointed out that prehydrolysis could be carried out with water alone, but that a temperature of 160 to 170°C. for at least 1 to 3 hr. would be required to obtain the desired results. A wartime development was the Waldhof procedure in Germany (*13*) for the manufacture of high grade viscose pulp from beechwood. The prehydrolysis stage took place at a temperature of 140°C. for 0.5 to 2 hr., followed by sulphate pulping and bleaching by conventional methods to give a final pulp with a yield of 38% and an alpha-cellulose content of 94% and a very low mannan content.

Recent work by Gohel and Thoria (*14*) indicated that a suitable rayon grade pulp could be produced from bamboo which is also a material rich in pentosans. The process used was the prehydrolysis sulphate one and it was claimed that a bleached pulp in an average yield of 33% containing 96.5% alpha-cellulose, 3.5% pentosans, 0.1% ash, and a D.P. of 800, was obtained. The pulp was further claimed to give good viscose solutions and easily converted into yarn.

Based on the results of various investigators in this field (*15*, *16*), a summary of the most important chemical characteristics of a suitable pulp for the viscose industry is assembled in Table I.

**Table I. Chemical Characteristics of a Suitable Viscose Pulp**

| | |
|---|---|
| Alpha-cellulose, % | Greater than 88.00 |
| Lignin, % | Less than 0.15 |
| Pentosan, % | Less than 5.00 |
| Ash, % | Less than 0.15 |
| Alcohol-benzene solubility, % | Less than 0.50 |
| Brightness (G.E.C.), % | Greater than 85.00 |
| Viscosity (TAPPI 1% cuprammonium), Cp | 5–25 |
| Copper number | 0.1–1.2 |

With this literature review and special reference to methods used for treating agricultural wastes, laboratory work was carried out to ascertain if satisfactory sulphate pulps could be prepared from bagasse for use in the viscose industry.

## EXPERIMENTAL WORK

The experimental work in this investigation was confined to a study of conventional sulphate pulping of bagasse (part I), acid prehydrolysis of bagasse (part II) and a two-stage process involving prehydrolysis followed by sulphate pulping (part III). In the straight sulphate pulping study, work was limited to an investigation of cooking time and temperature, while all other variables were held constant. In the study of prehydrolysis, the effect of certain variables like temperature, acid concentration and time were observed. Based on the above two studies, the optimum conditions were determined and the two-stage process carried out in an attempt to secure a pulp low in the undesirable pentosans and which would be suitable for conversion into viscose.

### *Bagasse Employed in Problem*

The bagasse used in this investigation was of Brazilian origin and received in bale form. Depithing was carried out by the dry method, and involved breaking up of the bale in hammer mill-type disintegrator, followed by screening over a 30-mesh wire sieve, whereby approximately 25% of the pith was removed.

The depithed bagasse was then stored in air-tight containers for use. The depithed and whole bagasse and also the separated pith were chemically analysed by TAPPI standard methods and the results tabulated in Table II. By comparison with those from wheat straw (*17*) and wood (*18*) the distinguishing difference in chemical composition between bagasse and the latter are thus brought about.

### *Method of Pulping*

A number of pulping trials were made on the depithed bagasse with sulphate cooking liquor, employing the same concentration of chemicals but varying the time and temperature. Pulping was carried out in a small stainless steel rotary digester of 10 l. capacity, thermostatically controlled and driven at a speed of about 2 r.p.m. The cooking schedule in each case involved 1 hr. for rise to maximum temperature and 1 hr. for cooling down, the chemical dosage employed being more or less similar to that used in commerical practice. At the end of each cook, the digester was drained and emptied and the cooked pulp thoroughly washed over a filter cloth until free of alkali.

**Table II. Comparison of the Chemical Composition of Sugar Cane Bagasse with Analyses of Wheat Straw and Wood**

| | Bagasse (Brazilian) | | | Wheat straw | Spruce | Birch |
|---|---|---|---|---|---|---|
| | Whole | Depithed | Pith | | | |
| Moisture, % | 11.80 | 11.80 | 11.80 | ... | ... | ... |
| Ash, % | 3.00 | 2.40 | 4.00 | 6.50 | 0.30 | 0.50 |
| $SiO_2$ in ash, % | ... | 71.00 | ... | 69.00 | ... | ... |
| $SiO_2$ in raw material, % | ... | 1.70 | ... | 4.50 | ... | ... |
| Extractives | | | | | | |
| Hot water, % | 4.60 | 5.00 | 7.60 | 10.90 | 2.10 | 2.10 |
| Alcohol-benzene, % | 3.80 | 3.30 | 5.30 | 4.10 | 2.30 | 3.20 |
| 1% NaOH, % | 39.00 | 26.00 | 44.50 | 31.80 | 11.60 | 19.30 |
| Cross and Bevan cellulose, % | 52.00 | 54.50 | 56.70 | 50.20 | 60.60 | 60.40 |
| Alpha-cellulose in C. & B. cellulose, % | 69.70 | 71.20 | 61.60 | 78.70 | 72.20 | 68.40 |
| Ash in C. & B. cellulose, % | 0.58 | 0.44 | 1.60 | 0.99 | 0.12 | 0.15 |
| Lignin, % | 21.50 | 20.50 | 23.60 | 15.70 | 27.80 | 24.80 |
| Pentosan, % | 29.10 | 25.30 | 29.40 | 26.70 | 12.05 | 26.00 |
| Resistant pure cellulose, % | ... | 33.80 | ... | 33.20 | 41.00 | 37.50 |

Analyses on moisture-free basis.

The washed pulp was then given a light mechanical treatment to complete defibration and the yield of unscreened pulp determined in each case. The unscreened pulp was further screened over a 0.15-mm. slotted screen plate and the percentage screenings determined. The screened yield was obtained by subtracting the weight of screenings from the weight of unscreened pulp. The screened pulp was next dewatered and allowed to air-dry. A small air-dry sample was shredded for analytical purposes.

### *Analysis of Unbleached Pulps*

The pulps obtained by the sulphate pulping of bagasse were analysed for their chemical properties in accordance with the following TAPPI standard procedures:

1. Bleach requirement.....TAPPI Standard T 219 m-54
2. Alpha-cellulose, %.....TAPPI Standard T 203 m-55
3. Lignin, %.....TAPPI Standard T 222 m-54
4. Pentosan, %.....TAPPI Standard T 223 m-48
5. Ash, %.....TAPPI Standard T 211 m-54
6. Alcohol-benzene solubility, %.TAPPI Standard T 6 m-54
7. Copper number, %.....TAPPI Standard T 215 m-50

## EXPERIMENTAL RESULTS

### *Part I*

1. *The Effect of Varying the Total Cooking Time.* The effect of varying the total cooking time from 2 to 5 hr. on the various pulp characteristics is shown in Table III.

**Table III. The Effect of Total Cooking Time on Properties of Depithed Bagasse Sulphate Pulp**

(Constant cooking conditions)

| | |
|---|---|
| Total chemical as $Na_2O$ used on weight of moisture-free bagasse, % | 20 |
| Sulphidity, % | 15 |
| Concentration of cooking liquor, g.p.l. | 28.5 |
| Liquor to fiber weight ratio | 7:1 |
| Maximum cooking temperature, °C. | 165 |
| Time to reach max. temperature, hr. | 1 |
| Time required at end of cook to drop pressure, hr. | 1 |

| | Cook no. | | | |
|---|---|---|---|---|
| | B-1 | B-2 | B-3 | B-4 |
| Total cooking time, hr. | 2 | 3 | 4 | 5 |
| Screenings, % | 1.80 | 0.51 | 0.62 | 0.25 |
| Yield of screened, unbleached pulp, % | 48.36 | 46.35 | 45.00 | 44.70 |
| Bleach demand, % chlorine | 9.40 | 7.37 | 6.94 | 7.20 |
| Analysis of unbleached pulp: | | | | |
| Alpha-cellulose, % | 79.13 | 82.31 | 81.92 | 81.41 |
| Lignin, % | 2.61 | 1.55 | 1.31 | 1.46 |
| Pentosan, % | 19.94 | 18.83 | 18.44 | 18.76 |
| Ash, % | 0.93 | 0.61 | 0.75 | 0.84 |
| Alcohol-benzene solubility, % | 0.79 | 0.64 | 0.61 | 0.69 |
| Copper number | 0.23 | 0.37 | 0.78 | 1.02 |

Yields, chemical consumption and analysis on moisture-free basis.

It will be seen from the results that the screened pulp yield and the screenings were not affected appreciably over the range of cooking times involved and were entirely satisfactory. The alpha-cellulose and the alcohol-benzene solubility did not change appreciably over the range of cooking time investigated. The ash content showed a slight tendency to increase with increase in cooking time and can be explained by the fact that more fines are produced as the cooking conditions become more drastic. These fines have a tendency to absorb more strongly the dissolved matter from the cooking liquor, which is difficult to wash clean and hence retained in the pulp.

The pentosan content, one of the most important properties of a viscose pulp, did not show any change over the range of cooking times studied and was found to be very high, ranging from 18 to 20%. Referring to Fig. 1, which shows the effect of cooking time on the bleach demand and lignin content of pulp, it can be seen that the lignin content decreased rapidly as the cooking time was increased from 2 to 3 hr., after which it decreased at a much less rapid rate. The bleach requirement decreased in the same manner as the lignin. In Fig. 2, the copper number, which is an indication of any chemical attack on the cellulose, was found to

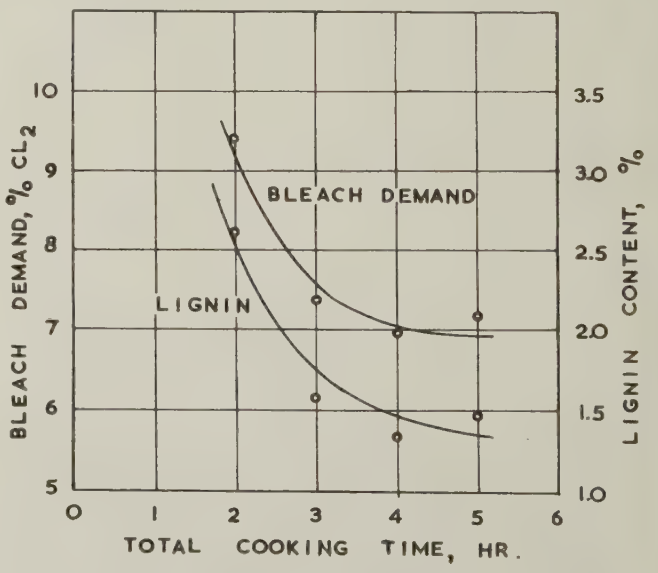


*Fig. 1. The effect of total cooking time on bleach demand and lignin content*

**Table IV. The Effect of Maximum Cooking Temperature on Properties of Depithed Bagasse Sulphate Pulp**

(Constant cooking conditions)

| | |
|---|---|
| Total chemical as $Na_2O$ used on weight of moisture-free bagasse, % | 20 |
| Sulphidity, % | 15 |
| Concentration of cooking liquor, g.p.l. | 28.5 |
| Liquor to fiber weight ratio | 7:1 |
| Time to reach max. cooking temperature, hr. | 1 |
| Time at max. cooking temperature, hr. | 3 |
| Time required at end of cook to drop pressure, hr. | 1 |

| | Cook no. B-2 | B-5 | B-6 |
|---|---|---|---|
| Maximum cooking temperature, °C. | 165 | 170 | 175 |
| Screenings, % | 0.51 | 0.47 | 0.53 |
| Yield of screened, unbleached pulp, % | 46.35 | 46.20 | 46.00 |
| Bleach demand, % chlorine | 7.37 | 7.40 | 7.25 |
| Analysis of unbleached pulp: | | | |
| Alpha-cellulose, % | 82.31 | 82.18 | 80.96 |
| Lignin, % | 1.55 | 1.60 | 1.44 |
| Pentosan, % | 18.83 | 18.64 | 18.69 |
| Ash, % | 0.61 | 0.69 | 0.78 |
| Alcohol-benzene solubility, % | 0.64 | 0.60 | 0.52 |
| Copper number | 0.37 | 0.63 | 0.91 |

Yields, chemical consumptions, and analysis on moisture-free basis.

increase slightly from 2 to 3 hr., after which the increase was very rapid.

2. *The Effect of Varying the Maximum Cooking Temperature.* The effect of varying the maximum cooking temperature from 165 to 175°C. on the various pulp characteristics is shown in Table IV.

From the results presented in Table IV, it was concluded that the maximum cooking temperature over the range studied had no effect on the screened pulp yields or the percent screenings. The alpha-cellulose

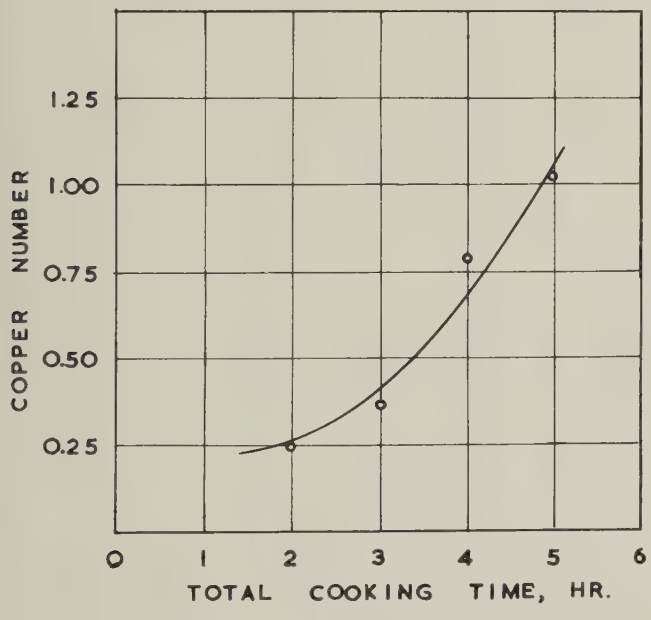


*Fig. 2. The effect of total cooking time on copper number*

showed a slight decrease at the highest temperature, while the alcohol-benzene solubility did not change appreciably. The ash content was high and had a tendency to increase with maximum cooking temperature. The copper number also showed an increase with cooking temperature, indicating that the cellulose was increasingly attacked as the maximum cooking temperature was raised, and the increasing ash content might again be explained by the formation of more pulp fines.

The data also indicated that the pentosan content was not appreciably affected by changing the maximum

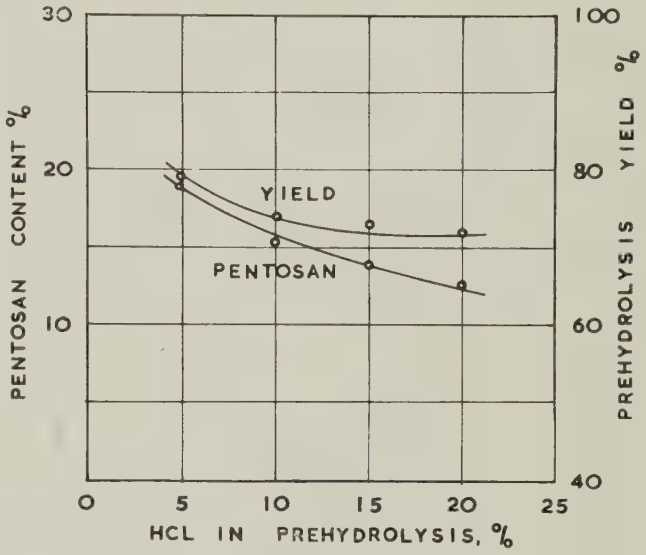


*Fig. 3. The effect of acid used in prehydrolysis on the pentosan content and yield*

cooking temperature. The lignin content was essentially constant and the bleach requirement was also found to remain constant over the range of temperatures studied. It will thus be seen that the effect of varying the total cooking time or the maximum cooking temperature did not result in a pulp low in pentosan, lignin and ash and high in alpha-cellulose, suitable to qualify as a viscose grade pulp.

***Acid Prehydrolysis—Study of Variables. Part II***

Before an attempt was made to subject the bagasse to the two-stage process, it was necessary to carry out a few preliminary trials on the prehydrolysis of the material under variable conditions of temperature, acid concentration and time in order to arrive at the optimum conditions for this stage.

A brief description of the general procedure was as follows: In each experiment a 10 g. (moisture-free) sample of the depithed bagasse was weighed out carefully in a 250-ml. rubber-stoppered bottle. Based on the moisture-free consistency to be maintained in the hydrolysis treatment, the calculated amount of water needed was carefully pipetted into the bagasse sample. The sample was then thoroughly disintegrated by means of an electric stirrer. While stirring, the calculated amount of hydrochloric acid was pipetted into the bottle, thoroughly mixed, and the bottle placed in a constant temperature bath which was regulated to some predetermined temperature. The mixture was kept constantly stirred. After the required time of acid treatment had elapsed, the prehydrolysed bagasse was filtered on a Buchner funnel and washed free of all residual acid. The moisture-free weight was then determined and the acid-treated material returned back to a clean stoppered bottle for analytical purposes.

Table V. The Effect of Temperature, Acid Concentration, and Time on Prehydrolysis Conditions

| *Expt. no.* | *HCl used, %* | *Temperature, °C.* | *Time, hr.* | *Moisture-free consistency, %* | *Yield, %* | *Pentosan on residue, %* |
|---|---|---|---|---|---|---|
| P.1 | 5 | 90 | 2 | 10 | 78.50 | 19.10 |
| P.2 | 10 | 90 | 2 | 10 | 74.60 | 15.30 |
| P.3 | 15 | 90 | 2 | 10 | 73.00 | 14.01 |
| P.4 | 20 | 90 | 2 | 10 | 72.00 | 12.85 |
| P.5 | 20 | 30 | 2 | 10 | 96.95 | 26.70 |
| P.6 | 20 | 50 | 2 | 10 | 95.46 | 25.90 |
| P.7 | 20 | 70 | 2 | 10 | 84.00 | 22.70 |
| P.8 | 20 | 90 | 4 | 10 | 68.60 | 10.52 |
| P.9 | 20 | 90 | 1 | 10 | 73.90 | 15.00 |
| P.10 | 20 | 90 | 0.5 | 10 | 74.90 | 15.20 |
| P.11 | 20 ($H_2SO_4$) | 90 | 2 | 10 | 74.40 | 15.91 |
| P.12 | 20 (HBr) | 90 | 2 | 10 | 74.90 | 16.00 |

Yields and chemical analysis on moisture-free basis.

The results of this acid-treatment investigation are shown in Table V.

The first acid-treatment variable studied was the amount of acid employed. For this series, the hydrolysis temperature was held constant at 90°C., the hydrolysis time at 2 hr. and the consistency at 10%. It was found that as the amount of acid employed was increased from 5 to 20%, more pentosans were removed, while the prehydrolysis yield decreased steadily (Fig. 3).

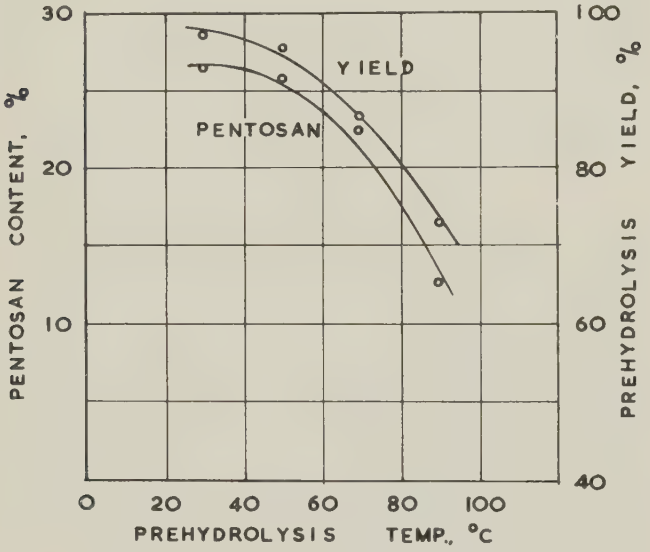


*Fig. 4. The effect of prehydrolysis temperature on the pentosan content and yield*

Employing 20% acid at consistency of 10%, the hydrolysis time was held constant at 2 hr. and the effect of hydrolysis temperature was investigated. It was noted that increasing the temperature from 30 to 90°C., the pentosan content was found to decrease steadily up to 70°C., after which a sharp and rapid drop was exhibited (Fig. 4.). The decrease in the yield also followed a similar pattern.

Still employing 20% acid at 10% consistency and taking 90°C. as hydrolysis temperature, a series of investigations were made to determine the effect of hydrolysis time. It was found that the pentosan content was not appreciably affected at the shorter reaction times, but tended to decrease appreciably under prolonged treatment, with a consequent loss in yield (Fig. 5).

From the above, it would seem that the acid concentration and temperature are the two important functions of the rate of reaction in prehydrolysis. Another function would be found in the degree of dissociation of the acid or acid salt employed for prehydrolysis. All other factors being equal, the more dissociated the acid, the more rapid the rate of hydrolysis of the carbohydrate constituents and it follows therefore that hydrochloric acid should promote the most rapid rate of reaction for prehydrolysis. The results in Table V clearly bear out this fact.

On completion of the prehydrolysis reaction, the spent hydrolyzate must be removed as completely as possible, as any residual acid would lead to the formation of the corresponding salt when the prehydrolysed residue is submitted to the alkaline digestion stage. In this connection, the use of sulphuric acid would be of advantage as the salt it forms can be utilised as a source of active chemical for the sulphate digestion; for most of the other acids, the resultant salts would be inert and their concentration may tend to build up to a possible disadvantage in the chemical recovery system.

*Re-use of Spent Hydrolyzate.* Although the possibility of reusing the spent hydrolyzate was not investigated, results of various investigators on the prehydrolysis of bamboo with sulphuric acid (*19*) showed that the waste acid could be reused successfully only once, a second reuse being found only partially effective in breaking down the pentosans.

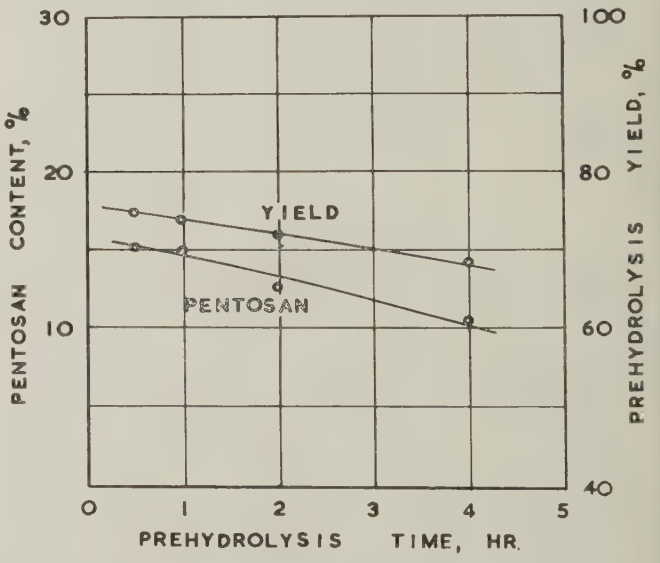


*Fig. 5. The effect of prehydrolysis time on the pentosan content and yield*

From the results of these investigations, the optimum

**Table VI. Acid-Prehydrolysis and Sulphate Pulping Trials on Depithed Bagasse**

| | | |
|---|---|---|
| Liquor to fiber ratio in prehydrolysis | | 10:1 |
| Liquor to fiber ratio in cooking | | 7:1 |
| Composition of cooking liquor as to combined $Na_2O$, % | NaOH | 65 |
| | $Na_2CO_3$ | 20 |
| | $Na_2S$ | 15 |
| Maximum cooking temperature, °C. | | 165 |
| Time to reach max. cooking temperature, hr. | | 1 |
| Time at max. cooking temperature, hr. | | 3 |
| Time required at end of cook to drop pressure, hr. | | 1 |

| | Cook no. | | | |
|---|---|---|---|---|
| | *B-7* | *B-8* | *B-9* | *B-10* |
| Pentosan of original bagasse, % | 25.30 | 25.30 | 25.30 | 25.30 |
| Prehydrolysis | | | | |
| HCl used, % | 20 | 20 | 20 | Hot water |
| Temperature, °C. | 90 | 90 | 90 | 165 |
| Time, hr. | 0.5 | 0.5 | 0.5 | 1.5 |
| Yield on bagasse, % | 74.30 | 74.00 | 74.00 | 74.10 |
| Pentosan of residue after prehydrolysis, % | 15.12 | 15.20 | 15.00 | 15.20 |
| Alkaline digestion | | | | |
| Total chemical as $Na_2O$ on wt. of prehydrolysed material, % | 20 | 25 | 30 | 30 |
| Screenings, % | 0.25 | 0.25 | 0.15 | 0.50 |
| Yield of unbleached screened pulp (on prehydrolysed bagasse), % | 41.60 | 40.70 | 39.60 | 41.50 |
| Yield (on depithed bagasse), % | 30.90 | 30.00 | 29.25 | 30.50 |
| Analysis of unbleached pulp | | | | |
| Alpha-cellulose, % | 87.00 | 88.20 | 91.90 | 91.20 |
| Lignin, % | 3.45 | 1.17 | 1.12 | 0.83 |
| Pentosan, % | 5.72 | 5.70 | 4.90 | 5.90 |
| Ash, % | 0.60 | 0.40 | 0.41 | 0.60 |

Yields, chemical consumptions, and analysis on moisture-free basis.

conditions for the prehydrolysis stage were found to be as follows:

| | |
|---|---|
| Acid employed based on weight of moisture-free bagasse, % | 20 |
| Moisture-free consistency, % | 10 |
| Temperature, °C. | 90 |
| Time, hr. | 0.5 |

***Acid-Prehydrolysis—Sulphate Pulping: Part III***

Based on the above optimum conditions, a series of trials were carried out on the depithed bagasse, involving acid prehydrolysis under optimum conditions, followed by alkaline pulping with sulphate cooking liquor. In the alkaline pulping stage, the chemical concentration was varied, all other conditions being held constant, in order to obtain a pulp of the desired quality. In cook no. B-10, prehydrolysis was carried out with water under high temperature and pressure, followed by alkaline cooking in the usual manner.

In these trials, both the prehydrolysis and alkaline pulping stages were carried out in a stainless steel rotary digester, which was thermostatically controlled. The pentosan content of the residue after prehydrolysis and also the analysis of the screened unbleached pulps, viz. alpha-cellulose, lignin, pentosan, and ash, were determined in each case according to TAPPI standards. Results of these are presented in Table VI.

*Bleaching of Pulps.* The screened, unbleached pulp from each cook was then bleached by a typical multistage process, involving chlorination at low pH, alkaline extraction, hypochlorite bleaching, and finally sulphur dioxide treatment, the purpose of the latter being to subject the pulp to a dilute acid wash to prevent color reversion. In the bleaching procedure, particular care was taken to preserve the purity and cleanliness of the pulps and for this purpose all intermediate washings between stages were carried out with distilled water. The yield of bleached pulp was determined in each case.

The bleached pulps were further analysed for the following physical and chemical properties (TAPPI Standard methods adopted): alpha-cellulose, lignin, pentosan, ash, alcohol-benzene solubility, copper number, viscosity, and brightness. The brightness values were measured by the E. E. L. spectrophotometer using 100% MgO as standard and the corresponding G.E.C. figures are also included. Complete data covering the bleaching treatment may be found in Table VII.

A comparison of the results on the pulp from cook

**Table VII. Multistage Bleaching of Sulphate Pulps from Prehydrolysed Bagasse**

| | Cook no. | | | |
|---|---|---|---|---|
| | *B-7* | *B-8* | *B-9* | *B-10* |
| Chlorination | | | | |
| Consistency, % | 2 | 2 | 2 | 2 |
| Time, hr. | 1 | 1 | 1 | 1 |
| Temperature, °C. | 16 | 16 | 16 | 16 |
| Chlorine consumed, % | 3.95 | 2.49 | 1.63 | 1.38 |
| Alkaline extraction | | | | |
| Consistency, % | 4 | 4 | 4 | 4 |
| Time, hr. | 0.5 | 0.5 | 0.5 | 0.5 |
| Temperature, °C. | 70 | 70 | 70 | 70 |
| NaOH consumed, % | 1.33 | 0.66 | 0.60 | 0.53 |
| Calcium hypochlorite bleach | | | | |
| Consistency, % | 4 | 4 | 4 | 4 |
| Time, hr. | 4 | 4 | 4 | 4 |
| Temperature, °C. | 30 | 30 | 30 | 30 |
| Available chlorine consumed, % | 1.54 | 0.85 | 0.90 | 0.73 |
| $SO_2$ treatment | | | | |
| Consistency, % | 4 | 4 | 4 | 4 |
| Time, hr. | 0.5 | 0.5 | 0.5 | 0.5 |
| Temperature, °C. | 16 | 16 | 16 | 16 |
| $SO_2$ added on pulp, % | 0.5 | 0.5 | 0.5 | 0.5 |
| Yield during bleaching, % | 95.40 | 98.70 | 99.00 | 98.80 |
| Yield on depithed bagasse, % | 29.40 | 29.60 | 28.90 | 30.20 |
| Yield on original raw bagasse, % | 22.00 | 22.20 | 21.70 | 22.60 |
| Analysis of bleached pulp | | | | |
| Alpha-cellulose, % | 90.30 | 91.70 | 93.85 | 94.22 |
| Lignin, % | 0.25 | 0.16 | 0.14 | 0.11 |
| Pentosan, % | 5.47 | 5.27 | 4.80 | 5.25 |
| Ash, % | 0.12 | 0.11 | 0.13 | 0.11 |
| Alcohol-benzene solubility, % | 0.60 | 0.64 | 0.41 | 0.47 |
| Copper number | 0.57 | 0.17 | 0.23 | 0.20 |
| Viscosity, cp. (1% Cuprammonium) | 10.70 | 13.20 | 13.70 | 14.40 |
| Brightness, % (E.E.L.) | 85.00 | 86.00 | 90.00 | 91.00 |
| Brightness, % (G.E.C.) | 84.00 | 85.00 | 89.00 | 90.00 |

Yields, chemical consumptions, and analysis on moisture-free basis.

Table VIII. Comparison of Chemical Properties of Bagasse Bleached Pulp (Cook No. B-9), with those Exhibited by Commercial Viscose Pulps

| | Commercial viscose pulps | | Bleached bagasse sulphate pulp (Cook no. B-9) | Requirements for viscose grade pulp as specified by literature |
|---|---|---|---|---|
| | Softwood sulphite | Hardwood sulphite | | |
| Alpha-cellulose, % | 91.00 | 89.40 | 93.85 | >88.00 |
| Lignin, % | 0.09 | 0.15 | 0.14 | < 0.15 |
| Pentosan, % | 3.02 | 4.45 | 4.80 | < 5.00 |
| Ash, % | 0.08 | 0.11 | 0.13 | < 0.15 |
| Alcohol-benzene solubility, % | 0.37 | 0.26 | 0.41 | < 0.50 |
| Copper number | 0.57 | 0.81 | 0.23 | 0.1–1.2 |
| Viscosity, cp. (1% cuprammonium) | 16.70 | 10.90 | 13.70 | 5–25 |
| Brightness, % (G.E.C.) | 94.00 | 93.00 | 89.00 | >85.00 |

All analysis on moisture-free basis.

no.B-9, with those obtained from the analyses of two commerical viscose pulps (chlorine dioxide bleached) and with the requirements for a viscose grade pulp obtained from literature, is shown in Table VIII.

Photomicrographs of the above mentioned pulps are also shown in Figs. 6, 7, and 8.

*Chemical Properties of Prehydrolysed Sulphate Bagasse Pulp.* Examination of the results in Table VIII showed that the bleached pulp resultant from cook B-9, conformed satisfactorily to the requirements of a viscose grade pulp and even compared favorably with those of two commercial viscose pulps. It is interesting to note that the ash content of the pulp was extremely low at 0.13% and similar to that normally exhibited by spruce sulphite pulps.

Xanthation of this pulp resulted in a clear viscose solution of low turbidity and can be expected to give good filterability values.

Viscosity determination on the bleached pulp indicated that the average chain length was similar to

***Fig. 6. Prehydrolyzed sulphate bagasse pulp from cook B-9***

that of spruce rayon pulps of the middle to high viscosity type. According to the table, the viscosity of a pulp could be any value from 5 to 25 cp., as long as the pulp was uniform. In other words, the pulp should not contain part high viscosity and part low viscosity cellulose. A low viscosity pulp, according to Richter (*20*), may be preferred for conversion to viscose, as the length of time required to age alkali cellulose is directly proportional to the original pulp viscosity. Although it has not been possible to determine the distribution of the degree of polymerization in the pulp, it is believed that actual fractionation and determination of the D.P. of each fraction would throw considerable light on the nature of this pulp.

The pentosan content of the pulp at 4.8% is a little higher than that of ordinary viscose rayon pulps, but

***Fig. 7. Commercial softwood sulphite dissolving pulp***

is within the prescribed limit insofar as the industry is concerned. In cook B-10, the pentosan content was slightly above the specified limit but could be further reduced by suitable adjustment of the prehydrolysis conditions within narrow limits.

The yield of bleached pulp varied between 28 and 30% which should be deemed quite satisfactory, particularly in view of the high alpha-cellulose content. Although the yield was low, it was more than accounted for by the high yield of furfural obtained. In Table IX a balance of furfural values at each stage of processing is given. It will be seen that the yield of furfural, calculated on the weight of depithed bagasse, was 8.35%, which corresponds to an overall yield of about 600 lb. of furfural per ton of pulp produced. The recovery of furfural from the spent hydrolyzate has been dealt with later in this article.

The results thus show that this two-stage process yields satisfactory viscose pulps from bagasse, while at the same time admitting the possibility of recovering

valuable by-products. A comparison of processes leading to the manufacture of suitable viscose pulp from bagasse is also shown in Table X.

## COMMERCIAL FEASIBILITY OF THE PROCESS

Although laboratory data showed that suitable viscose grade pulp could be prepared from sugar cane bagasse by a dry depithing and prehydrolysis sulphate

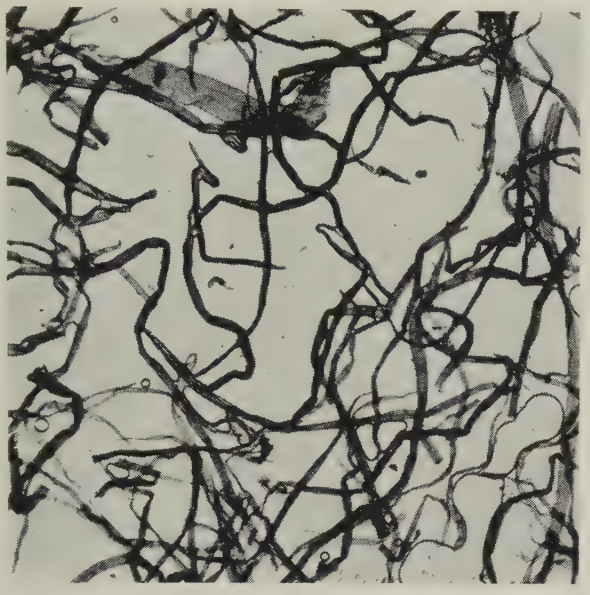

*Fig. 8. Commercial hardwood sulphite dissolving pulp*

method, it is believed that commercial application of the process could be feasible, provided an effective utilization is made of the separated pith and provision made for the recovery of by-products.

### *Depithing Bagasse*

One of the first requirements for a successful utilization of bagasse for viscose pulps is the quality of the raw material. The bagasse must be of good quality and completely free from pith, which, because of its nature and condition and its accompanying extraneous matter as it exists in the bagasse at the time of leaving

**Table IX. Balances of Furfural Values at Various Processing Stages (Cook No. B-9).**

| | *Furfural of substance, %* | *Furfural present in substance (on original depithed bagasse), %* | *Furfural calculated on original amount present, %* | *Furfural removed in stage, calculated on original amount present, %* |
|---|---|---|---|---|
| Original depithed bagasse | 14.88 | 14.88 | 100.00 | 0.00 |
| Bagasse after prehydrolysis | 8.83 | 6.53 | 43.85 | 56.15 |
| Pulp after alkaline digestion | 2.88 | 0.85 | 5.70 | 38.15 |
| Pulp after bleaching | 2.82 | 0.81 | 5.44 | 0.26 |

Analysis on moisture-free basis.

the sugar mill, would be highly detrimental to the production of a high quality pulp. If left in the fiber, the pith would consume an excessive amount of chemicals, result in a pulp difficult to bleach and render the final product unsuitable for chemical conversion. On the other hand, if the pith is removed and discarded, the yield of pulp will be too low to permit economic operation. The solution to this would be an efficient and effective commercial means of separating the pith from the fiber, followed by some economic use of the pith. In recent years, bagasse pith mixed with molasses is finding extensive use as a major constituent in high carbohydrate stock feed.

**Table X. Comparison of Processes Leading to Suitable Viscose Pulp from Depithed Sugar-cane Bagasse**

| *Process* | *Yield of bleached pulp on depithed bagasse, %* | *Alpha-Cellulose content of bleached pulp, %* | *Pentosan on bleached pulp, %* |
|---|---|---|---|
| 1. Cooking with sulphate liquor of appropriate composition and concentration | 45–47 | 75–80 | 25–28 |
| 2. Relatively stronger cooking (soda or sulphate liquor) | 38–41 | 80–85 | 15–18 |
| 3. Mild sulphate cooking, followed by alkaline extraction in the cold | 30–34 | 88–92 | 8–10 |
| 4. Prehydrolysis, followed by sulphate cooking | 28–30 | 90–94 | 4–6 |

Yields and chemical analysis on moisture-free basis.

Separation of pith could be carried out either by dry or wet method. The former consists essentially of further disintegrating the bagasse, then passing the mass through some type of screen to sift out the pith. This method is being used in practically all of the commercial operations now producing pulp from bagasse and represents the most obvious and easiest method for utilizing the pith. The wet method involves thorough wetting and softening the bagasse, mechanical agitation sufficient to break the pith away from the fiber, wet screening to effect sharp separation of pith from fiber and finally dewatering both pith and fiber and processing pith for further use. Although both methods are commercially efficient, it is claimed (*21*) that the wet process attains a greater degree of freedom of dirt and debris than the dry process.

### *Pulping Equipment and Materials of Construction*

The prehydrolysis stage, whether by added acid or acid given off during hydrolytic treatment, involves a pH below 5 and hence iron digesters would not be suitable due to corrosion and special acid resisting vessels may be necessary. Owing to the highly absorbent and bulky nature of bagasse, vertical stationary digesters with liquor circulation systems, as are now commonly used in conventional wood pulping would be impracticable and digesters of the rotating type would be essential to ensure satisfactory circulation and good heat transfer with a reasonably high liquor to fiber ratio. These could be of the vertical tumbling type leading to specially designed blow pits where separation of the spent hydrolyzate and washing of the prehydrolyzed residue would take place. The alkaline digesters could also be of the rotary type, either in mild steel or stainless steel and provided with suitable blow tanks.

### *Recovery of Furfural*

The production of furfural from pentosans is divided

into two stages, the first involving the acid catalysed hydrolysis of pentosans into pentoses and the second the dehydration of the pentoses into furfural. The actual mechanism of the hydrolysis process has been the subject of some study (22–26).

To understand this mechanism, it is necessary to consider how the pentosan themselves are related to the main cellulose body. The hemicelluloses of the cell membrane are a group of constituents which, unlike cellulose are largely soluble in dilute alkali and are readily hydrolyzed to pentoses and hexoses. Their function appears to be either that of reserve materials as in kernals and seeds or that of structural materials in wood, straws etc. On hydrolysis, these structural group materials yield chiefly pentoses, of which xylose and to lesser extent arabinose are the most common. Various other substances are associated with the pentosan in the hemicellulose group such as the polyuronides which on hydrolysis give uronic acid. Thus, while the bulk of the hydrolysis product is xylose, there will be some glucose, galactose, arabinose, and uronic acid present.

Very little work appears to have been done on the analysis of bagasse from the hemicellulose hydrolysis point of view, but reference to Table IX indicates that the theoretical yield of furfural from bagasse is in the region of 15%, though the actual yield would be somewhat lower. The actual yield, as obtained in this investigation, was 8.35% on the weight of depithed bagasse.

A study of literature reveals (*27*, *28*) that the recovery of furfural from the spent hydrolyzate can be effected either by single-stage operation involving continuous steam distillation of the furfural from the mass as soon as it is formed in the digester or by two-stage operation involving hydrolysis of the pentosans, followed by dehydration of the pentoses at elevated temperature after their separation from the cellulosic material.

It would appear that when the demand for furfural is large, the raw material cheap and the ligno-cellulose can be regarded as a waste, the single-stage operation provides the most economical method of furfural production. However, when the main product is high-alpha pulp and furfural a by-product, the two-stage operation would be the preferred procedure.

## SUMMARY AND CONCLUSIONS

1. Bagasse, depithed by a dry method, was pulped with relative ease by the sulphate process.

2. The pulps produced were universally high in pentosan content, the per cent pentosans ranging from 18 to 20%.

3. The pentosan content could not be reduced by varying the cooking time from 2 to 5 hr., nor by varying the cooking temperature employed from 165 to 175°C., all other cooking conditions being constant.

4. The pentosans, however, were materially reduced by an acid prehydrolysis, sulphate pulping process, pulps with pentosan content of from 4 to 6% being obtained.

5. In the acid hydrolysis stage of the process, the temperature was the most important variable, the amount of acid employed and length of hydrolysis treatment followed in order.

6. The optimum conditions for acid hydrolysis were 90°C. temperature, 20% acid based on weight of moisture-free bagasse, 30 min. reaction time, and 10% moisture-free consistency.

7. In the sulphate pulping stage, the quantity of chemical employed was the most important variable, the optimum cooking conditions being 25 to 30% $Na_2O$ on the weight of moisture-free prehydrolyzed bagasse, 15% sulphidity, 3 hr. at 165°C.

8. The pulp made by this investigation, after bleaching by orthodox methods, gave a product which compared favorably with commercial grades of viscose pulp and exhibited the following properties: alpha-cellulose 93.85%, pentosan 4.8%, ash 0.13%, brightness (G.E.C.) 89%, and viscosity (TAPPI) 13.7 cp.

9. On xanthation, the above mentioned pulp yielded a very clear viscose solution.

10. The dry depithing and prehydrolysis sulphate procedure was found to be suitable for the manufacture of viscose grade pulp from bagasse and provided effective use is made of the separated pith and furfural recovered as a by-product, the process can be commercially feasible, particularly in countries with limited resources of softwood and abundant supplies of bagasse and agricultural residues.

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# Minton Vacuum Driers

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**The rate of evaporation is a function rate of heat input, and vapor concentration immediately adjacent to evaporating liquid. When drying is conducted in an open drier there is a probability that in some areas there will be a high vapor concentration, which will cause an increase in temperature of the liquid phase approaching the boiling point. In a vacuum drier the vapor concentration is held at a low value in all parts of the drier. This results in a large increase in drying rate and a much lower maximum temperature of the pulp or paper web. To accomplish this, evaporation machinery is enclosed in a pressure tight shell. The sheet enters and leaves through rolling seals so designed that air infiltration is minimized. Vapor is condensed and noncondensible air is removed by a vacuum pump. Care must be taken to avoid too rapid evaporation at the wet end driers. When estimating cost of a vacuum drier in comparison with an open drier, consideration should be given to its compactness. A smaller machine room and minimum requirements for air circulation are credits. Overall costs of entire department show it to be competitive. In operation, its efficiency in heat utilization is much higher than with open driers. Operating crew should have specialized training, but not to extent of requiring higher wage rates than comparable jobs on other types of machines. Quality of product dried at lower temperature is better retained.**

BEFORE we attempt to describe the unique features of the Minton drier, it will be helpful to review the mechanism of evaporation. Our field of interest is the process as it takes place from the surface of a relatively pure liquid.

Within a liquid the constituent particles or molecules move about in short random paths. The distance of motion depends upon how far a molecule can go before it collides with another, and the velocity depends upon the temperature and the angle of the collision. It is not unlike the break on a pool table, where temperature effect can be compared to the energy of the cue ball, and velocity of individual balls varies as a result of many collisions.

The surface film of a liquid resists the escape of molecules, and only the most active can breach the barrier and escape into the space surrounding the liquid. If heat is supplied to the liquid, more molecules are energized to escape velocity. It is not a one way proposition, however. Some of the molecules in the vapor space will re-enter the liquid, and the net result of the process depends upon the supply of heat to the liquid and upon the concentration of vapor molecules, close to the liquid, which can re-enter.

If we provide a way of continuous removal of vapor space molecules which will reduce chance of re-entry, evaporation will proceed more rapidly. High energy molecules escape the liquid and are withdrawn, and leave behind those of lower average energy. Since molecular energy and temperature are much the same thing, removal of the most active results in a lowering of temperature of the liquid.

We can now specify the character of a Minton vacuum drier: it is a machine which dries a web of wet material by supplying heat in the conventional manner, and reduces vapor density by maintaining a pressure in the vapor space that is much below that of the normal atmosphere. A rigid, pressure tight, enclosure of cast iron resists the pressure of the atmosphere. The sheet of pulp or paper enters and leaves through seals which allow very little leakage of air into the vacuum space. Vapor from the sheet is drawn into a condenser. Any air leakage into the drier is compressed back to atmospheric pressure by a positive displacement vacuum pump and discharged to the air outside the building.

If the pressure inside the drier casing has been reduced to one fifth that of the atmosphere at sea level—a 24-in. vacuum-evaporation takes place by boiling at 141°F. A cubic foot of space will contain only 0.0083 lb. of saturated vapor uniformly from one end of the drier to the other. As fast as the vapor is released it passes through the porous drier felt, or from the sheet between driers, and goes from the drier to the condenser.

In a drier operated at atmospheric pressure and in blind areas where vapor can only escape by equaling the pressure of the air, the temperature of evaporation would reach 212°F. and each cubic foot of such restricted space would contain 0.0374 lb. of vapor—$4^1/_2$ times as much as in the example selected for the Minton. Of course, designers of open driers make every effort to eliminate such blind areas and provide strong currents of air to sweep away concentrated vapor.

Open driers—those which use drying rolls and which are not Mintons—are nowadays provided with elaborate hoods, exhaust trunks and fans, and high velocity jets to sweep out vapor concentrations. These additions have justified themselves through increased production, more uniform drying, and improved conditions in the machine room. Yet even at their best such auxiliaries do not make an open drier the equal of a Minton when water removal at lowest practicable temperature is the purpose of the machine. For a given tonnage, the Minton only requires about half the number of drier rolls required by an open drier. Careful measurements of temperature adjacent to the sheet of an open drier will show that in the web of paper or pulp the temperature at which evaporation is taking place is much above that in the Minton. The same grade of pulp when dried in the open drier comes out somewhat lower in brightness than when dried in a Minton. With paper, a Minton drier might fail to supply a high enough temperature to set a rosin size.

Ogden Minton, in a paper entitled "Thermodynamic Comparison of Paper Drying Methods," calculates heat balances for the two types of driers. He was able

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to correlate these with tests of actual machines, showing the Minton better than 90% efficient in its use of heat energy for evaporation of water from newsprint. The more carefully conducted tests on open driers showed efficiencies between 50 and 60%. This difference in efficiency is due to the use of large quantities of air to move evaporated moisture from the drier. This air is heated in order to avoid condensation and sweating, and part of the heat requirements are expended in raising the temperature of the water vapor content of the air from its outdoor level, entering, to its final temperature upon discharge.

If efficient use of steam was the only consideration in the purchase of a drier, there would be little use in making this talk, for the Minton would be used by everyone. Unfortunately it does not lend itself to such inserts as smoothing presses, machine coaters, and other trimmings which adorn the modern large paper or board machine.

Let us assume for a moment that the desired coater, or other device, could be installed in a Minton and given satisfactory service. There is still a serious deterrent to the universal application of a Minton for paper drying. We have seen that within the drier casing the evaporation limits the maximum temperature at all places within the drier to that at which water boils within such low pressure surroundings. This is a fine condition for drying pulp, or a slack sized sheet such as newsprint or mimeograph. But when the customer wants a well-sized sheet, it has been found that a higher temperature is necessary to "fuse" the size than will be obtained in a normally operated Minton. The Minton is designed to remove water efficiently at a low temperature; and when it is necessary to produce a hot sheet, we lose the desired basic results of the invention without gaining an efficient paper drier.

The most striking feature of a Minton is the air-tight casing which surrounds the drying rolls. This casing is an assembly of heavily ribbed and flanged iron castings. All mating surfaces are machined accurately to an overall tolerance per casting of plus or minus a couple of thousandths of an inch. Opposite faces must be parallel. The pluses and minuses in tolerance seem to average out, so that assembly is made with reasonable speed and a vacuum tight casing results.

This is an imposing result, for in a 52-drier machine such as was installed at Cosmopolis, Wash. there is about 1 mile of jointed surface in the framing and a quarter of a million square inches of machined surface. Some 11,000 bolts are used to assemble the casing flanges. In addition there are 60 inspection doors or port holes, 52 access doors to the drier front head manholes, six larger doors for working access to the vacuum chamber, and 350 circular openings for drier bearings, drier journal packing on back side, felt rolls, and so forth. These openings require another 4000 bolts which are mostly assisted by air pressure on the cover.

The total weight of such a Minton drier section is approximately 3,000,000 lb., with about two thirds in the drier casing. The structure is still very much the same as it was when designed by Ogden Minton and his staff over thirty years ago, but benefits from modern improved foundry procedures and machine tools.

The castings which form the top and bottom of the drier span the full width of the machine. Bottom castings rest upon sole plates at front and back sides. Top castings frame one or more openings for attachment of the vapor outlet pipe manifold leading to the condenser. Three openings are usual on larger pulp drying machines. These frame castings must carry in compression a part of the atmospheric pressure on the front and back sides of the drier, and also the atmospheric pressure from top or bottom.

Internal pipe columns extend from front to back casing, about one third and two thirds of the way up, and carry a portion of the pressure on these external surfaces. External pressure amounts to about 1700 lb. per sq. ft. (depending upon absolute pressure in the casing and barometric status of external atmosphere).

When necessary, individual castings or groups of castings can be unbolted and jacked out of the casing to permit access to internal equipment. At the Everett sulphite mill this was done to permit replacement of the front heads of three driers, which had developed leaks that resisted correction. No difficulties were experienced either in removal or replacement. The need for this type of repair is a rare occurrence and may not be experienced during the entire long life of some machines.

Drying rolls are two high, staggered to permit maximum wrap. The ingoing sheet is directed to a bottom drier, and goes out from a top drier—therefore, an even number of driers will result. Felt driers are not necessary, resulting in a compact casing of roughly rectangular profile. No basement is required, and the overhead crane need not be very high in order to clear the overhead vapor pipe.

The rolls are conventional design, usually 5 ft. diam. and face about 2 in. more than width of pulp sheet. The heads bolt to the barrel. A drier roll certified for a maximum pressure of say 50 p.s.i. gage in an open drier would be allowed 10 to 12 lb. less steam pressure for service in a Minton, since external atmospheric pressure is reduced by that amount.

Older Minton driers mounted the back-side drier bearings on the journal in a pocket in the drier casing, with a packing gland on the outer side of the bearing. Present practice is to install the packing in the frame, and carry the bearing on a bracket outboard of the packing follower nut. The bearing is tapered roller mounted to take thrust. The changed location reduces a danger that leaking packing will blow bearing lubricating oil onto the sheet.

The journal, and consequently the bearing, approach the temperature of the drier steam. Lubricating oil should be circulated through the bearing and a filtration system, and should be of a grade able to resist carbonization and sludge formation at the high temperature.

Front side bearings are mounted in the frame. They are cylindrical roller design to permit float of the journal as the drier changes dimension through thermal expansion. In this location it has been possible to use a bath of oil extending part way up on the rollers at their lowest travel. There is little tendency for the oil to carbonize, but a good grade is needed. Oil can be changed only when the machine is down and vacuum is off.

The Minton driers which are operated by Weyerhaeuser are equipped with one top drier felt and one bottom. These must be operated at maximum safe tension in order to obtain a good drying rate and to guide properly. An asbestos-faced cotton felt is used. Under service conditions the felt will stretch and in so doing decrease in width. The manufacturer can control these dimensional changes to some extent, but provision must be made for stretching by providing a manually operated felt take-up as well as one actuated by weights. Felt tension is regulated by varying the number of weights, and will be decreased as the felt nears the end of its useful life or when the felt seam shows signs of weakness.

Drier felt rolls are made by assembling cast ends in 12-in. pipe. Standard weight pipe is adequate for normal loads, but so many drier felt rolls have been damaged by drier plugs that better economy is obtained by specifying extra heavy pipe at the time a machine is ordered.

The felt roll journals are equipped with tapered roller bearings, and although temperature change is much less than in the drier it is still necessary to be sure that one end is arranged to take thrust and the other end has ample room to float. A good grade of grease can be used as lubricant, but never in excess quantity since the only way out of the bearing retainer is toward the sheet of pulp or paper.

Timely replacement of felt roll bearings before the journal is damaged is difficult, if not at times impossible. With adequate down time the machine crew can slack off the drier felt and test the rolls for easy operation. When running, the oiler or back tender can at times hear the noise of a defective bearing. Power consumption gives a clue if the machine has an electric drive. Excessive heat is sometimes a clue. When detected it is not always possible to arrange a shutdown in time to prevent such damage as to necessitate a roll change. It is a good procedure to have some spare rolls ready for installation at very short notice.

So far in this description we have developed a casing to enclose driers, so that the operation can be performed in a vacuum. Nothing has been said of the problem of introducing or removing a sheet of paper or pulp. This is not a simple batch process where a load is wheeled in, a door closed, and the pumps started. Even after the final wet press the sheet is easily wrinkled or broken. Air leakage must be kept to a minimum, maintenance must be reasonable, and the seal must operate for days or weeks without replacement of any of its components. Some 50 to 90 miles of sheet per day will enter or leave through the seal assemblies on a pulp drying machine, and a much greater length on a paper machine. How is it done?

The ingoing seal can be visualized by drawing a base line 1 in. long sloping up from left to right at about 45° and making it the hypotenuse of a right angle triangle of equal legs, with the right angle above the base line. Then place a cent coin centered on each corner of the triangle. The lower two coins represent in cross section the two metal seal rolls, which are 16 in. in diam., are made from a solid forging of steel, and have rigid journals able to support atmospheric pressure acting upon the assembly from above. The face of these rolls is plated with hard chromium, then polish ground to leave a coating about 0.010 in. thick.

The upper coin represents the rubber covered seal roll. Its metal core is a thick walled tube 14 in. in diam., with a rubber coating about 1 in. thick. The rubber is medium soft (105 plastometer) so it will deform to pass the sheet but seal at the ends of the roll in front and in back of the sheet.

Two resilient wiping seals are placed in cast channels extending across the machine end frames, to prevent leakage at the left side of the left "penny," and a similar two at the right side of the right coin. A pocket in the casting between the seals is supplied with a flow of water to wet the chromium-plated surface and give a very low running friction between the roll and the wiping part of the seal.

The wiping seal is pressed uniformly against the full face of the roll by an inflated tube. Control of inflating pressure allows a proper compromise between a dry metal surface attained by excessive rubbing, and one that is so wet that water is transferred to the sheet.

During the many years that the Minton drier has been operating, a great deal of experience and skill has been accumulated by the operators and maintenance men. A detailed description of this information is outside the scope of this talk, but should certainly be obtained by anyone who contemplates the operation of one of these machines.

The outgoing seal is much like the ingoing, except that the entering sheet goes down into the nip between the bottom drier felt and the first drier; but the outgoing sheet goes down from the last drier into the seal rolls. The rubber-covered roll is therefore below at the outgoing end. A cable arrangement attachs to the bearing housings of the outgoing rubber seal roll to pull it up into running position and hold it there until there is sufficient vacuum to hold it into position. Differential pressure between room air and drier internal pressure is more than adequate to maintain contact—its pressure on the rubber covered seal roll is about 12 tons on a machine designed for 150-in. trim, at an operating vacuum of 24-in. of mercury. It is necessary to carry part of this load on the bearings of the rubber covered seal rolls. This is done by adjustable bearing support pads which are set to support the roll some 0.010 in. away from contact with chromium-plated rolls. Usually the rubber covering of the roll will be pulled into contact as air is pumped from the casing—if not, then the pads can be temporarily moved to close the gap, then returned to proper running position. Failure to relieve some of the load on the rubber can cause loss of a rubber covering job in a very short time.

At each end of each seal roll is a renewable metal ring. On the chromium-plated rolls these end rings are currently made of stainless steel which is ground to the same diameter as the roll. For the rubber covered rolls the end rings are bronze, ground to $^1/_{32}$ in. smaller radius than the rubber each time the covering is reground. The end faces of seal roll end rings are the moving part of the vacuum seal. The stationary part of the end seal is a molded ring of graphite material. Initial pressure is obtained by applying a small pressure to a follower piece to compress an O-ring which contacts the stationary seal. Machine vacuum on the O-ring

supplies sufficient pressure during operation. These end seals are now quite reliable, after a history of several changes in make-up and sources of supply of the various components.

During normal operation a pulp drying machine might be drying 15 air-dry tons per hour, the sheet entering at 45% air-dry and leaving at 100% air-dry. Water removed by evaporation is $18^1/_3$ tons per hr. At a vacuum of 24 in., temperature of saturated vapor is 141°F. and it occupies 120.7 cu. ft. per lb. Vapor flow through the outlets is about 74,000 c.f.m., and velocity through three 24-in. openings is 130 f.p.s. This 90 mile per hr. stratospheric gale was able to carry over enough pulp fiber to plug periodically the vapor side of a surface condenser, but handles quite well in a barometric condenser and delivers all of the heat of vaporization back to the mill in warm water for process use.

The air remaining in the upper part of the condenser head is continuously withdrawn and compressed by one stage of steam ejectors, passed through an aftercooler, and finally discharged to atmosphere by a single cylinder double acting "dry vacuum" pump. A centrifugal separator just ahead of this pump has been found essential, to remove water droplets and prevent excessive maintenance on the pump inlet valves.

Occasional adjustment of steam supply to the ejectors and variation of the number in use permits the backtender to control the machine vacuum at a level suitable to the type of pulp that is being dried. The following tabulation gives an idea of the wide range of drying conditions that might be encountered.

| | |
|---|---|
| Bleached hardwood sulphite | 17–18 in. vacuum |
| Unbleached sulphite | 21–23 in. vacuum |
| Bleached paper grade sulphite | 22–24 in. vacuum |
| Bleached dissolving sulphite | 24–25½ in. vacuum |
| Bleached kraft | 24–26 in. vacuum |
| Newsprint (Mr. Minton's data) | 28 in. |

There are other factors, besides type of pulp, which affect the selection of vacuum. Any method of heating the sheet to assist in wet end water removal must be limited to temperatures below the boiling point in vacuum dryer—internal boiling will cause the sheet to explode or "blow." The pressure of steam in the first few driers at the ingoing end of the drier should be graduated from very low to higher, to avoid blowing. Some species of wood yield a pulp which is more sensitive to high vacuum than others, and as the table indicates, the degree of bleaching has some effect. This is very definitely an area where a cautious start is indicated until experience has shown the boundaries between safe, risky, and foolish.

The steam supply system conforms to pattern just indicated: the dry end rolls receive the main supply at high pressure. The steam that leaves these driers, along with the condensate, is delivered to a smaller group of driers near the wet end, and the lesser amount that leaves these is used in the first one or two driers. The precise pattern will vary between machines according to type of pulp and desire of the machine room foreman. Removal of broke from a Minton is so arduous a task that the tendency would be to stay in a safe range of drier operating pressures.

Since the first drier rolls are operated at an internal steam pressure below atmospheric, a vacuum pump is necessary for condensate removal. This is usually arranged to handle noncondensable gas and a little vapor remaining after a chilling spray. Liquid is removed by a centrifugal pump with float control regulation of its discharge.

The use of a Minton vacuum drier does not impose any special restriction upon the selection of the machine drive. In some installations a turbine and line shaft drive is used, in others an electrical drive and controls.

When management plans a new pulp mill, the selection of a Minton for the drying of pulp will be complicated by details which have been discussed and others that now come to mind. The first cost is bound to be considered. Here you would imagine that the Minton would be at a serious disadvantage, but such is not the case. The purchase will involve an entire machine room containing a pulp machine capable of some definite capacity. The Minton requires about half the number of drier rolls necessary in an open machine, and is consequently either shorter or lower or both. It does not need a basement or a hood. Machine room air supply and exhaust systems will be much smaller in the machine room where drying is done by a Minton. All costs considered, the investment in each installation will total nearly the same.

To get best results from a vacuum drier, the crew must know its peculiarities and how to operate it, and the maintenance crew know how to maintain it. Present day pulp mill employees have, in addition to pay that goes with their jobs, a very real investment in retirement benefits, seniority, vacation privileges, and community standing. It is apt to be difficult for a new mill to assemble a crew which will include as its core enough trained and capable men for a good start-up. As an alternative, some on the job training in a Minton equipped mill might be arranged and would be worth the cost and effort in bringing it about.

There will be times of trouble with any paper or pulp machine when the entire crew will be fighting broke, and not be numerous enough to get the job done as fast as is desired. New equipment which is available for cutting and baling, or for finishing rolls, tends to reduce the manpower needed for those purposes. The time may come when we will have reached a limit in automation in the dry end area because we must have a certain minimum crew to handle the work in times of trouble, and supply the apprentice backtenders and machine tenders.

In conclusion, mention must be made of the advantages which a Minton drier provides in the quality field. It dries at a lower average temperature than an open drier, and consequently the product suffers less loss of strength and brightness. During drying there is no contact between the sheet and large volumes or air, removing one possible source of fine dirt.

These advantages, coupled with its high capacity, efficiency in use of steam, freedom from climatic and weather variables, and efficient return of heat of vaporization make the Minton vacuum drier an excellent machine for economical production of pulp and certain grades of paper.

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# Spent Sulphite Liquor VI.

## *Consideration of Ammonium Spent Sulphite Liquor Processes Using Ion Exchange Resins**

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**Preliminary calculations have been made of material balances and equipment requirements for a process directed toward recovery of ammonia from ammonium spent sulphite liquor by use of a cation exchange resin. The resin is regenerated with sulphurous acid recovered from furnace stack gas to provide an ammonium bisulphite solution suitable for reuse. The process does not appear to be economically attractive. If the resin is regenerated with sulphuric acid, ammonium sulphate is produced as a by-product.**

INFORMATION relating to a process for recovery of ammonia as well as sulphur dioxide and useful heat by treating ammonium-base spent sulphite liquor using ion exchange resins has been obtained in this laboratory. Results have been submitted concerning the recovery of ammonia obtained by operating batch resin columns under certain conditions (*1*), and also concerning the equilibrium distribution of ammonium ions between resins and spent sulphite liquor or sulphurous acid solutions (*2*). These and other data are used in this paper to obtain an evaluation of the process compared with such other processes as pyrolysis of ammonium spent sulphite liquor (*3*).

Recovery of heat and sulphur dioxide from ammonium-base spent sulphite liquor is being obtained at certain times during the year at the Lebanon, Ore. mill of the Crown Zellerbach Corp. (*4*). The liquor is evaporated, solids are burned, and useful steam is recovered from the furnace-boiler system. The ammonia is lost by combustion in the furnace but the sulphur is converted largely to sulphur dioxide which leaves the furnace in the stack gases. These are cooled and then passed through an absorption tower countercurrent to a "make-up" ammonium hydroxide solution into which they are absorbed to yield an ammonium bisulphite solution suitable for re-use in processing.

To extend this type of treatment so that recovery of ammonia as well as of heat and sulphur dioxide might also be obtained, consideration has been given to the use of ion exchange resins to remove ammonia from the liquor so that what goes to the furnace for burning is hydrogen-base spent sulphite liquor. The recovery of ammonia from the resin and also the regeneration of the resin can be accomplished by passing an acidic solution over the resin. Regeneration of the resin is best done by use of a solution of a strong acid, such as hydrochloric or sulphuric acid. If sulphuric acid were used, the treatment would yield ammonium sulphate which might be a process by-product as discussed below.

Another possible regenerant is a sulphurous acid solution which could be obtained in a sulphite pulp mill either from the accumulator system or, possibly, from the stack gas resulting from burning hydrogen-base spent sulphite liquor. The following two major difficulties exist with respect to use of sulphurous acid for this purpose: firstly, under useful conditions it is only partly ionized and thus relatively large quantities of total sulphurous acid are needed to provide the effective regenerant bisulphite ions necessary for the ammonium ion to be stripped from the resin, and, secondly, sulphur dioxide is present in stack gas at low concentration and its recovery therefrom to provide a sulphurous acid solution is expensive.

However, the prospect that resin regeneration with sulphurous acid available in a closed cycle inside a pulp mill might permit partial recovery of ammonia to provide a useful ammonium bisulphite solution seemed to justify some preliminary design calculations based on sulphurous acid regeneration. Such calculations have now been carried out for the process outlined in the flow sheet given as Fig. 1. This process flow sheet indicates equipment and operations which might be used for the ion exchange resin treating, for the absorption of suphur dioxide from stack gas and concentration to the degree necessary for use as a regenerant for the ion exchange resin.

The calculations have been carried out assuming that: (a) an ammonium-base sulphite pulp mill producing 100 tons of pulp per day is to be considered; (b) the spent sulphite liquor is collected and evaporated to 50 wt. % total solids concentration for ion exchange resin processing; (c) the spent sulphite liquor solids treated amount

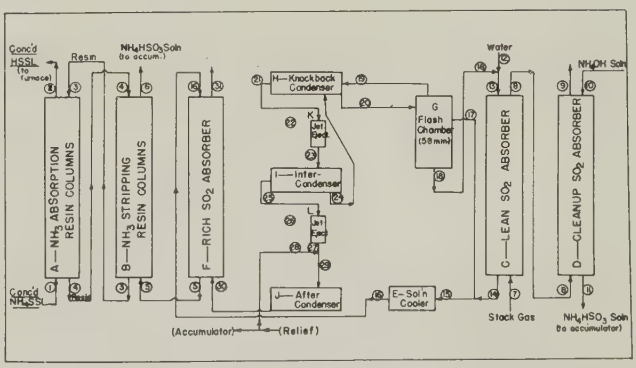


*Fig. 1. Outline of scheme for recovery of ammonia and sulphur dioxide from ammonium spent sulphite liquor using ion exchange resin*

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* Contribution V of this series was published in *Tappi* 37: 431.

## NOMENCLATURE

- $a$ interfacial mass transfer area, sq. ft. per cu. ft. of tower (sq. ft. per ft. of tower height in a tower of unit cross sectional area).
- $d$ differential operator
- $h$ tower height, ft.
- $H$ height of a transfer unit, ft.
- $K$ overall mass transfer coefficient, moles/sq. ft./hr.
- $L$ anion capacity in moles of hydrogen or ammonium ions per hour in *SSL*
- $N$ number of transfer units
- $R$ anion capacity in moles of hydrogen or ammonium ions per hour in resin
- $S$ anion capacity in moles of hydrogen or ammonium ions per hour in sulphurous acid solution to form bisulfite
- *SSL* spent sulphite liquor
- $X$ fractional conversion of replaceable acid groups to ammonium groups in *SSL*, resin, or sulphurous acid, consistent with definitions of $L$, $R$, and $S$

Subscripts and Superscripts

- $B$ tower bottom
- $L$ refers to spent sulphite liquor
- $O$ overall basis, considering the total resistance to mass transfer between the first phase bulk concentration and the second phase bulk concentration
- $R$ refers to resin
- $S$ refers to sulphurous acid solution
- $T$ tower top
- $*$ concentration or fractional conversion in the phase indicated by the subscript, which would be in equilibrium with the bulk concentration of the other phase.

to 105 tons per day; (d) 100 lb. of these solids consist of 3.9 lb. of ionizable ammonia, 7.3 lb. of sulphur, and 88.8 lb. of organic solids; (e) the combustion of spent sulphite liquor solids yields all sulphur as sulphur dioxide in the stack gas at a partial pressure of 7 mm. of mercury when the total pressure is 1 atm.

## ION EXCHANGE RESIN PROCESSING

Prior experiments in this laboratory were conducted processing spent sulphite liquor or sulphurous acid using batch column treatments (*1*). However, since continuous countercurrent operating methods are being studied in this Laboratory and elsewhere (*5*, *6*, *7*), and since treatment of such steady state systems is relatively simple, the present preliminary calculations of absorption and stripping column performance were carried out assuming that continuous counter-current equipment was available and practical for installation. An example arrangement for an ion exchange absorption and stripping column system is shown in Fig. 2.

These calculations are based on knowledge of the equilibrium distribution of ammonium ion between the ion exchange resin and the spent sulphite liquor or the sulphurous acid solution. These equilibrium data have previously been obtained and reported (*2*). For

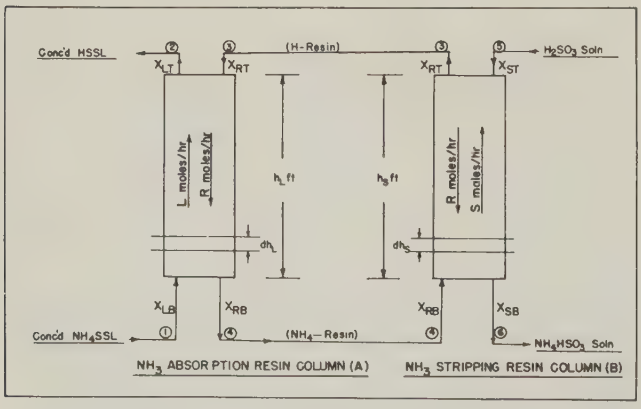


*Fig. 2. Arrangement of ion exchange resin columns for absorption and stripping of ammonium ions*

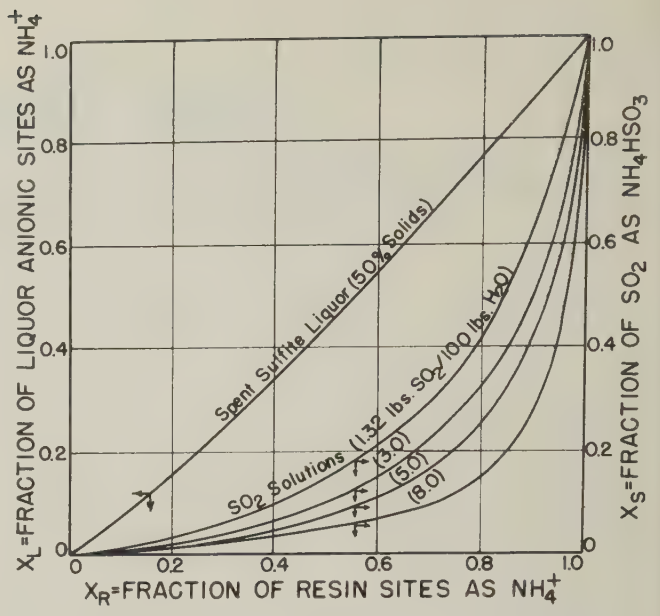


*Fig. 3. Equilibrium distribution of ammonium ions between Dowex 50 and spent sulphite liquor and between Dowex 50 and sulphurous acid*

the present case, it is assumed that the sulphonated Dowex 50 (8% crosslinked with divinylbenzene) is used.

The equilibrium data of present interest are given in Fig. 3. Here the ordinate $X_L$ represents the fraction of conversion of spent sulphite liquor acids to ammonium salts, and the ordinate, $X_S$, the fraction conversion of sulphurous acid to ammonium bisulphite. The abscissa, $X_R$, represents the fraction of conversion of the resin sulphonate sites to ammonium salts. The spent sulphite liquor-resin equilibrium line was obtained by smoothing the results of prior experiments, while the sulphurous acid-resin equilibrium lines were calculated from the known value of the first ionization constant of sulphurous acid ($K_{25°C.} = 1.72 \times 10^{-2}$) and by taking the ammonium-hydrogen selectivity ratio as 1.2 for the Dowex resin (*2*).

Suppose we consider the two column system of Figs. 1 and 2 where the ion exchange resin circulates continuously counter-current to spent sulphite liquor in the absorber and to sulphurous acid solution in the stripper. The letters $L$, $R$, and $S$ designate the anion capacity in moles of hydrogen or ammonium ions per hour in the streams of spent sulphite liquor, or resin, or sulphurous acid with respect to bisulphite formation. For a differential length of the absorption or stripping tower, the following material balances can be set up for the ions exchanged:

$$LdX_L = RdX_R \quad (1)$$

$$SdX_S = RdX_R \quad (2)$$

Since $L$, $R$, or $S$ are each assumed to remain constant as a stream passes through a column, then integration between the limits of the top and bottom, $T$ and $B$, of the column gives the equations for the operating lines for the columns as:

$$\frac{(R)}{(L)} = \frac{X_{LT} - X_{LB}}{X_{RT} - X_{RB}} \quad (3)$$

and

$$\frac{(R)}{(S)} = \frac{X_{ST} - X_{SB}}{X_{RT} - X_{RB}} \quad (4)$$

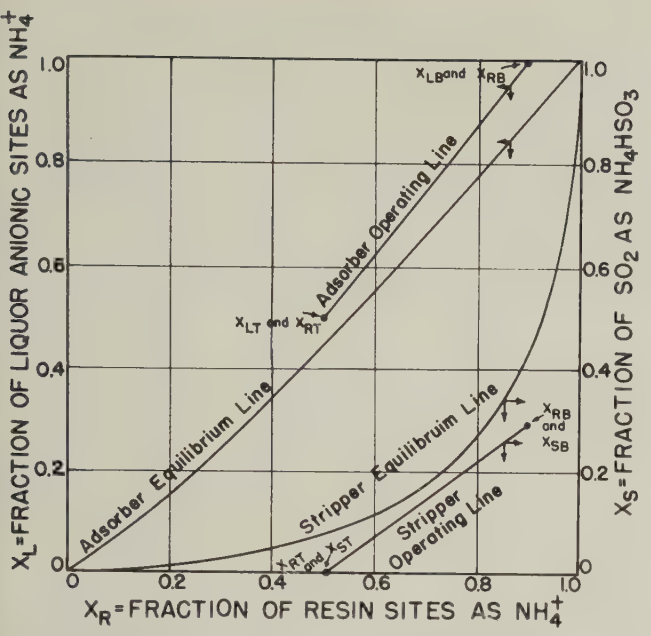


*Fig. 4. Equilibrium and operating lines for 50% recovery of ionizable $NH_4^+$ using ten-stage ion exchange columns*

For example, if an ammonium spent sulphite liquor is considered to enter an absorption tower entirely as an ammonium salt to $X_{LB} = 1.00$ and to have half this ammonia absorbed so that $X_{LT} = 0.50$, and if the resin enters the tower half saturated with ammonium so that $X_{RT} = 0.50$, then the minimum flow ratio, $(R/L)_{\text{min.}}$, obtains when the resin leaves the column at equilibrium with the liquor fed, i.e., where the operating line becomes tangent to the equilibrium line which is:

$$\left(\frac{R}{L}\right)_{\text{min.}} = \left(\frac{X_{LT} - X_{LB}}{X_{RT} - X_{RB}}\right)_{\text{min.}} \qquad (5)$$

However, in practice this ratio cannot be attained because no concentration difference between the phases remains present at one end of the column. Thus some larger value of $(R/L)$ must be used to provide finite and sufficient concentration differences at every point in the column so that practical ammonia transfer can be achieved. Operating lines with such $(R/L)$ ratios are shown in Fig. 4 for absorption and for stripping columns and are characterized by their finite departures from the equilibrium lines.

These concentration differences existing at a differential tower height, $dh_L$ or $dh_S$, can be used as is usual in chemical engineering design (*8*) to establish the following material balance equations;

$$LdX_L = K_{OL}\, a(X_L - X_L^*)dh_L \qquad (6)$$

$$SdX_S = K_{OS}\, a(X_S^* - X_S)dh_S \qquad (7)$$

which can be rearranged to give:

$$\frac{dX_L}{X_L - X_L^*} = \frac{(K_{OL}\, a)}{(L)}\, dh_L = \frac{(1)}{(H_{OL})}\, dh_L \qquad (8)$$

$$\frac{dX_S}{X_S^* - X_S} = \frac{(K_{OS}a)}{(S)}\, dh_S = \frac{(1)}{(H_{OS})} dh_S \qquad (9)$$

where the over-all heights of transfer units, $H_{OL}$ or $H_{OS}$, are perhaps preferable to use because they often vary less with flow rates than do the transfer coefficients.

Integration of these expressions, using values of $H_{OL}$ and $H_{OS}$ averaged over the length of the columns gives

$$h_L = H_{OL} \int_{X_{LB}}^{X_{LT}} \frac{dX_L}{X_L - X_L^*} = (H_{OL})\,(N_{OL}) \qquad (10)$$

$$h_S = H \int_{X_{SB}}^{X_{ST}} \frac{dX}{X_S^* - X_S} = (H_{OS})\,(N_{OS}) \qquad (11)$$

$N_{OL}$ and $N_{OS}$ are numerical values of the integral functions called the "number of transfer units," and they are used to express the extent of mass transfer duty required to be performed in a column.

Thus if a column is operated at some assumed set of values for $(R/L)$ and for terminal stream compositions, then the position of the operating line is fixed and the calculation of the required number of transfer units can be made by graphical integration. If the height corresponding to one transfer unit is known, then by equations (10) or (11) one can calculate the height of an absorption or a stripping tower necessary to accomplish the specified change in stream composition. Tower diameters are fixed by necessary flow rates and mechanical considerations.

For present calculations, the arbitrary assumption was made that absorption and stripping columns would each operate under conditions which would provide ten transfer units. Operating lines drawn on this basis are shown in Fig. 4. In the absorption column, the ammonia in the spent sulphite liquor is reduced by half, i.e., from $X_{LB} = 1.00$ to $X_{LT} = 0.50$, while the resin is simultaneously changed from $X_{RT} = 0.50$ to $X_{RB} = 0.90$. Likewise in the stripping column, the resin is regenerated while the sulphurous acid solution changes from $X_{ST} = 0.00$ to $X_{SB} = 0.29$. This latter value indicates that less than one-third of the sulphurous acid capacity to form ammonium bisulphite has actually been used. This low efficiency in use of the sulphurous acid regenerant arises because of the limited degree of ionization of the sulphurous acid and not much increase in $X_{ST}$ would be attained even if a column

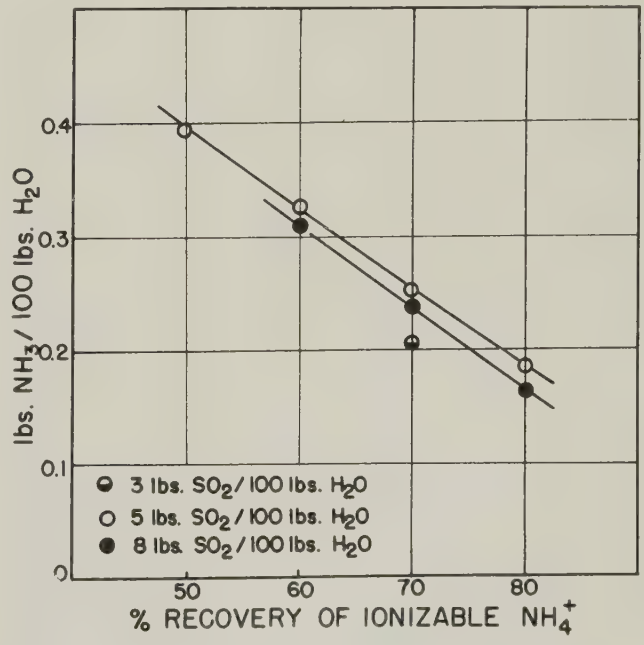


*Fig. 5. Estimated ammonia concentration in ammonium bisulphite stream 6 from resin column B*

**Table I. Estimated Compositions of Streams in Operation of Ion Exchange Resin Column System**

(Component flow rates in pounds per hour)

| Stream number and nature | Soln. component | @ 3 lb./100 lb., $NH_3$ Rec., 70% | $SO_2$ Soln. @ 5 lb./100 lb. $H_2O$ — $NH_3$ recovery | | | | $SO_2$ Soln. @ 8 lb./100 lb. $H_2O$ — $NH_3$ recovery | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 50% | 60% | 70% | 80% | 60% | 70% | 80% |
| 1. Conc. $NH_4SSL$ to $NH_3$ abs. resin column | $NH_3$ | 340 | 340 | 340 | 340 | 340 | 340 | 340 | 340 |
| | $SO_2$ | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 |
| | $H_2O$ | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 |
| 2. Conc. HSSL from $NH_3$ abs. resin column | $NH_3$ | 102 | 170 | 136 | 102 | 68 | 136 | 102 | 68 |
| | $SO_2$ | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 | 1,280 |
| | $H_2O$ | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 | 9,250 |
| 3. Resin to $NH_3$ abs. resin column and from strip. column | $NH_3$ | 119 | 212 | 163 | 119 | 78 | 163 | 119 | 78 |
| | $SO_2$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Resin | 4,750 | 5,080 | 4,880 | 4,750 | 4,650 | 4,880 | 4,750 | 4,650 |
| 4. Resin from $NH_3$ abs. resin column and to strip. column | $NH_3$ | 357 | 382 | 367 | 357 | 350 | 367 | 357 | 350 |
| | $SO_2$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Resin | 4,750 | 5,080 | 4,880 | 4,750 | 4,650 | 4,880 | 4,750 | 4,650 |
| 5. $SO_2$ solution to $NH_3$ strip. resin column | $NH_3$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | $SO_2$ | 3,520 | 2,180 | 3,130 | 4,720 | 7,160 | 5,300 | 7,180 | 13,300 |
| | $H_2O$ | 117,200 | 43,500 | 62,600 | 94,500 | 143,200 | 66,200 | 89,800 | 166,000 |
| 6. $(NH_4H)SO_3$ solution from $NH_3$ strip. resin column | $NH_3$ | 238 | 170 | 204 | 238 | 272 | 204 | 238 | 272 |
| | $SO_2$ | 3,520 | 2,180 | 3,130 | 4,720 | 7,160 | 5,300 | 7,180 | 13,300 |
| | $H_2O$ | 117,200 | 43,500 | 62,600 | 94,500 | 143,200 | 66,200 | 89,800 | 166,000 |

provided an infinite number of transfer units. The flow ratios, $(R/L)$ and $(R/S)$, existing in the absorption and stripping columns, respectively, can be computed from the terminal conditions by use of equations (3) and (4).

Now if the ammonia recovery from the spent sulphite liquor is to be increased, then it can be seen from Fig. 4 that $X_{LT}$ must be decreased and this can be accomplished only if regeneration of the resin is improved so that $X_{RT}$ is also decreased. However, if operations are conducted at lower $X_{RT}$, the result is that $X_{SB}$ must also be reduced to a still lower value indicating an even lower efficiency of use of the sulphurous acid for regeneration in the stripping column.

The total ammonia and sulphur dioxide concentrations in the stream leaving the stripping column can be increased by increasing the inlet concentration of sulphurous acid stripping solution. However, this causes the sulphurous acid equilibrium line to become less favorable (see Fig. 3) and again tends to decrease sulphurous acid regeneration efficiency.

These relationships indicate that there is some optimum sulphurous acid solution concentration characterized in that it is sufficiently low to permit moderately efficient resin regeneration, and thus perhaps moderately efficient sulphite liquor ammonia recovery, and yet sufficiently high to yield ammonia from the stripper at an absolute concentration which is high enough to permit the stream to be used directly in the accumulators after flashing off excess sulphur dioxide. Calculations have been made of the absolute concentration of ammonia in the regeneration column effluent as a function of the percentage ammonia recovered from spent sulphite liquor and of the concentration of sulphurous acid in the stripping solution and results are given in Table I and Fig. 5.

The optimum sulphurous acid concentration at 25°C. appears to be about 5%. It also appears that high recovery of spent sulphite liquor ammonia cannot be obtained, using sulphurous acid regeneration, under conditions which give arise to ammonia in the stripper effluent at a concentration sufficiently high to be directly useful in an accumulator. To see what might be done if only moderate recovery of ammonia could be entertained, additional and more detailed preliminary design calculations were carried out for the cases of 70

**Table II. Estimated Compositions of Streams in Process for 50% Ammonia Recovery**

(Sulphurous acid regenerant = 5 lb. $SO_2$/100 lb. $H_2O$)

| Stream number (see Fig. 1) | Components,[a] lb./hr. — $NH_3$ | $SO_2$ | Gas inerts | $H_2O$ | Total |
|---|---|---|---|---|---|
| 1 | 340 | 1280 | 0 | 9,250 | 10,890 |
| 2 | 170 | 1280 | 0 | 9,250 | 10,700 |
| 3 | 170 | 0 | 0 | ... | 170 |
| 4 | 340 | 0 | 0 | ... | 340 |
| 5 | 0 | 2180 | ... | 43,500 | 45,680 |
| 6 | 170 | 2180 | ... | 43,500 | 45,850 |
| 7 | 0 | 1280 | 51,300 | 8,390 | 60,870 |
| 8 | 0 | 640 | 51,050 | 2,390 | 54,080 |
| 9 | 0 | Neg. | 51,050 | 2,390 | 53,440 |
| 10 | 170 | 0 | 0 | 5,000 | 5,170 |
| 11 | 170 | 640 | 0 | 5,000 | 5,810 |
| 12 | 0 | 0 | 0 | 28,000 | 28,000 |
| 13 | 0 | 731 | 0 | 1,822,000 | 1,822,731 |
| 14 | 0 | 1371 | (5.84)[b] | | 1,828,360 |
| 15 | 0 | 29 | 0.13 | 36,360 | 36,389 |
| 16 | 0 | 29 | 0.13 | 36,360 | 36,389 |
| 17 | 0 | 1342 | 5.71 | 1,792,000 | 1,793,342 |
| 18 | 0 | 731 | 0 | 1,794,000 | 1,794,173 |
| 19 | 0 | 630 | 5.71 | 5,420 | 6,050 |
| 20 | 0 | 19 | ... | 7,854 | 7,873 |
| 21 | 0 | 639 | 5.71 | 356 | 995 |
| 22 | 0 | 0 | 0 | 2,494 | 2,494 |
| 23 | 0 | 639 | 5.71 | 2,850 | 3,489 |
| 24 | 0 | 28 | ... | 2,790 | 2,818 |
| 25 | 0 | 611 | 5.71 | 60 | 671 |
| 26 | 0 | 0 | 0 | 1,940 | 1,940 |
| 27 | 0 | 611 | 5.71 | 2,000 | 2,611 |
| 28 | 0 | 1540 | | 5,140 | 6,680 |
| 29 | 0 | 2151 | 5.71 | 7,140 | 9,291 |
| 30 | 0 | 611 | 5.71 | 2,000 | 2,611 |
| 31 | 0 | Neg. | 5.84+ | ... | ... |

[a] SSL also contains about 7770 lb./hr. of inert organic material.
[b] Moles per hour.

**Table III. Estimated Material Balance on Accumulator[a] in Process for 50% Ammonia Recovery**

(Sulphurous acid regenerant = 5 lb. $SO_2$/100 lb. $H_2O$)

| Stream number and nature | Components, lb./hr. — $NH_3$ | $SO_2$ | $H_2O$ |
|---|---|---|---|
| Input | | | |
| Relief gas | 0 | 1,650 | 5,500 |
| $NH_3$ strip. col. eff. | 170 | 2,180 | 43,500 |
| Clean-up $SO_2$ abs. eff. | 170 | 640 | 5,000 |
| Make-up $SO_2$ | 0 | 64 | 0 |
| Make-up $NH_3$ | 38 | 0 | 0 |
| Output = input total | 378 | 4,534 | 54,000 |

[a] Weight per cent composition of pulping liquor is estimated to be 0.64% $NH_3$, 7.62% $SO_2$ and 91.74% $H_2O$.

**Table IV. Estimated Capital Cost Indices**

| Equipment | Size or duty | Cost for process flowsheet Fig. 1 | Fig. 6 | Fig. 7 |
|---|---|---|---|---|
| Ion exchange column system | | | | |
| $NH_3$ absorber (A) | 10,000 lb./hr. | $ 30,000 | $ 30,000 | $ 30,000 |
| $NH_3$ stripper (B) | 120,000 lb./hr. | 350,000 | 350,000 | 300,000 |
| $SO_2$ absorption towers (brick-lined steel) | | | | |
| Lean $SO_2$ (C) | 183 sq. ft. × 30 ft. | 31,000 | ... | ... |
| Clean-up $SO_2$ (D) | 38 sq. ft × 10 ft. | 6,500 | 6,500 | 6,500 |
| Rich $SO_2$ (F) | 5 sq. ft. × 10 ft. | 1,200 | 1,200 | ... |
| $SO_2$ absorption tower packing (1-in. Raschig rings) | | | | |
| Lean $SO_2$ (C) | 1460 cu. ft. | 9,000 | ... | ... |
| Clean-up $SO_2$ (D) | 190 cu. ft. | 1,200 | 1,200 | 1,200 |
| Rich $SO_2$ (F) | 50 cu. ft. | 300 | 300 | 300 |
| Flash chamber (G) | 1.2 ft. × 6 ft. diam. | 14,000 | ... | ... |
| Pump | 36,500 g.p.m. | 8,000 | ... | ... |
| Motor | 100 hp. | 4,500 | ... | ... |
| Ejectors (K & L) | 3 in. parallel | 6,000 | ... | ... |
| Heat exchangers | | | | |
| Reflux condenser (H) | 17,100 sq. ft. | 135,000 | ... | ... |
| Intercondenser (I) | 2,410 sq. ft. | 20,000 | ... | ... |
| After condenser (J) | 9,610 sq. ft. | 29,000 | 29,000 | ... |
| Solution cooler (E) | 250 sq. ft. | 5,200 | 5,200 | 5,200 |
| 5% $SO_2$ cooler (F) | 242 sq. ft. | 5,000 | ... | ... |
| Internal cooler (F) | 250 sq. ft. | 5,200 | 5,200 | ... |
| Stack gas blower (E) | 22,400 cu. ft./m. | 4,000 | 4,000 | 4,000 |
| Evaporator | 600 sq. ft. | ... | ... | 14,000 |
| Spray drier | 1000 lb. $H_2O$/hr. | ... | ... | 49,000 |
| Total installed cost | | 665,100 | 432,600 | 410,200 |
| Plant cost | | 1,650,000 | 1,080,000 | 1,130,000 |
| Capital cost/day (based on 10-year amortization, 6% interest, 300 days operation /yr.) | | 910 | 600 | 570 |

and 50% recovery of spent sulphite liquor ammonia using 5% $SO_2$ regenerant solution and these results are given below.

The use of two or more resin columns in series was considered as a method for possibly improving the extent of spent sulphite liquor ammonia recovery and of the stripper effluent ammonia concentration. By internally recycling either resin or regenerant, one can to some exent change the $R/L$ ratios in the columns considered and thus change the slopes of the operating lines. However, all multiple column systems investigated proved to be less desirable than single column systems because whatever advantage was gained by use of two or more operating lines to get around the curve of the equilibrium line for the stripper was more than offset by the necessary changes in slopes of the absorber column operating lines associated with the recycled resin streams.

## SULPHUR DIOXIDE ABSORPTION AND CONCENTRATION

If ammonia is to be stripped from an ion exchange resin by use of sulphurous acid, then provision must be made to supply to the resin system the sulphurous acid in appropriate amounts and concentrations. Assuming that the spent liquor is passed through ion exchange resin columns to remove ammonia and is then burned, nearly all of the sulphur in the liquor will appear in the furnace stack gas in the form of sulphur dioxide. To provide the needed regenerant sulphurous acid, it has been considered that sulphur dioxide might be absorbed from the furnace stack gas, concentrated, and perhaps supplemented by relief gases. One particular scheme for conducting this processing as well as the ion exchange resin processing is outlined in Fig. 1.

Here the above discussed ion exchange resin operations are conducted in ammonia absorption resin column A and ammonia stripping resin column B while stream 5 is the sulphurous acid solution entering and stream 6 is the ammonium bisulphite-sulphurous acid solution leaving column B. Cooled furnace stack gas (stream 7) containing sulphur dioxide at about 7 mm. Hg partial pressure passes through the lean $SO_2$ absorber C and then through clean-up $SO_2$ absorber D from which it is discharged to the atmosphere. Sulphur dioxide is absorbed in D into make-up ammonium hydroxide stream 10 which is added in amounts appropriate to

**Table V. Estimated Daily Cost Indices**

| | Costs ($/day) for process flowsheet Fig. 1 | Fig. 6 | Fig. 7 |
|---|---|---|---|
| Cost item | | | |
| Capital | $ 910 | $ 600 | $ 570 |
| Maintenance and repairs | 90 | 60 | 57 |
| Supervision and overhead | 135 | 90 | 135 |
| Labor | 300 | 200 | 300 |
| Utilities | 40 | 15 | 20 |
| Materials[a] | | | |
| Ammonia[a] | 180 | 180 | 360 |
| Sulphur dioxide[a] | | 130 | |
| Sulphuric acid[a] | | | 180 |
| Resin | 65 | 65 | 65 |
| Total | $1720 | $1340 | $1687 |

[a] Based on *Chem. Eng. News*, Dec. 29, 1958.

**Table VI. Relative Cost Comparison of Processes**

| | Based on process flowsheet Fig. 1 | Fig. 6 | Fig 7 |
|---|---|---|---|
| Estimated values recovered[a] | | | |
| Ammonia | $360 | $360 | $360 |
| Sulphur dioxide | 260 | 260 | 260 |
| Ammonium sulphate | 0 | 0 | 400 |
| Total values recovered | 620 | 620 | 1020 |
| Estimated total costs | 1720 | 1340 | 1687 |
| Estimated values less costs | $−1100 | $−720 | $−667 |

[a] Based on *Chem. Eng. News*, Dec. 29, 1958.

provide stream 11 as a useful ammonium bisulphite solution. A water scrubber section is used at the top of D to avoid ammonia loss. Water (streams 12 and 18) at 40°C. and in large amounts enters C and the resultant sulphurous acid stream 14 is in part cooled to provide stream 16 while the remaining part is vacuum flashed in G to yield a vapor stream 19 along with a liquid stream 18 which is recirculated. The vacuum flashing step was found to be less costly than stripping at atmosphere pressure which would require heating of the enormous quantity of water involved. Condensers H, I and J with ejectors K and L serve to compress and cool the flashed vapor which is mixed with some relief gas to provide concentrated sulphurous acid stream 30. This gas at about atmospheric pressure is introduced into the rich $SO_2$ absorber F where it is absorbed into cooled dilute sulphurous acid stream 16 to provide the sulphurous acid stream 5 desired for stripping ammonia from the ion exchange resin in B. Unabsorbed sulphur dioxide and various inerts in stream 31 are vented to absorber C. Sulphur dioxide loss, estimated at 5% per cycle, is considered to be made up by additions to stream 28.

## ECONOMIC CONSIDERATIONS

Preliminary calculations have been carried out relative to the process steps of Fig. 1 for recovery of 50% of the ionic ammonia in the spent sulphite liquor fed when the ion exchange resin was considered to be regenerated with a solution of 5 lb. of $SO_2$ per 100 lb. of water. Estimated stream compositions are shown in Tables I and II and the material balance calculated for the accumulator is given in Table III.

Equipment to accomplish the desired process steps was characterized as to type, material, and size. Costs were very roughly estimated using the compilations of Zimmerman and Lavine (*9*), Aries and Newton (*10*), and the chemical Engineers Handbook (*8*). Resin column costs were estimated by the procedure of Peak and David (*11*). The Marshall and Stevens Index (*12*) of comparative equipment costs was employed to adjust prices to a common 1958 base. The capital and operating cost estimates are in Tables IV and V and the summary given in Table VI indicates unfavorable economic prospects for the scheme.

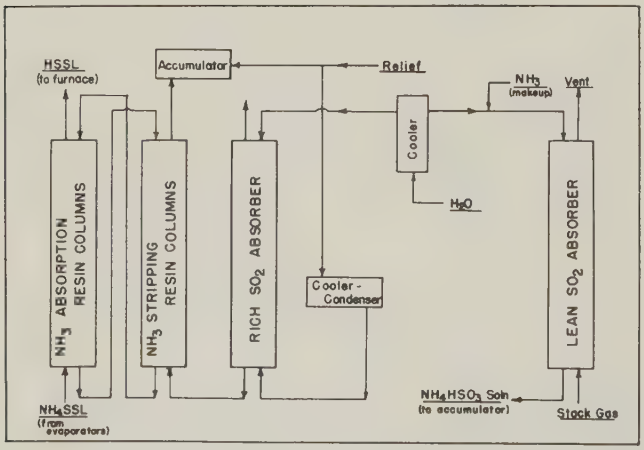


*Fig. 6. Outline of scheme for partial recovery of ammonia and sulphur dioxide from ammonium spent sulphite liquor using ion exchange resin*

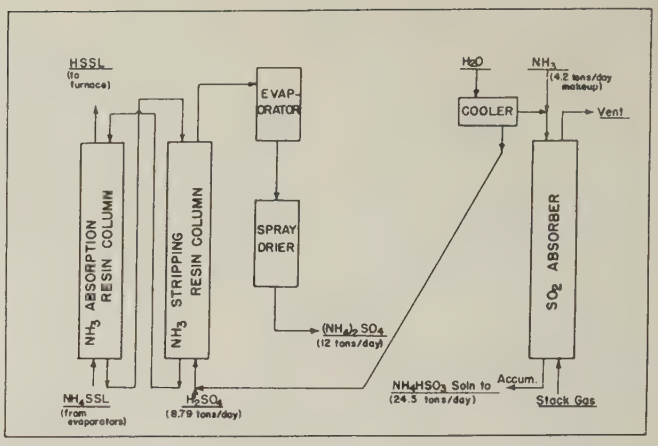


*Fig. 7. Outline of scheme for recovery of ammonia and sulphur dioxide with production of ammonium sulphate from ammonium spent sulphite liquor using ion exchange resin with sulphuric acid regeneration*

For 70% ammonia recovery, the ion exchange process equilibrium-operating line relationship shown in Fig. 3 gives rise to a lower ammonium ion concentration in the resin stripping column effluent. Also, a smaller proportion of concentrated ammonium bisulphite solution is available from the clean-up absorber since the make-up ammonia is now only 30%. The result is a pulping liquor containing only 0.37 wt. % ammonia compared with about 0.64 wt. % ammonia when 50% recovery is practiced. Consideration of equipment and operational requirements such as are shown in Tables IV and V indicated that processing for 70% ammonia recovery is even less attractive than for 50% recovery.

To avoid the costly recovery of dilute sulphur dioxide from stack gases using water, some consideration was given to the process of Fig. 6 whereby sulphur dioxide would be recovered only to the extent that it could be absorbed into the make-up ammonium hydroxide in the lean $SO_2$ absorber. Tables IV and V show cost estimates for this scheme.

To avoid the unfavorable equilibrium relationships associated with use of sulphurous acid for resin regeneration, some consideration was also given to the process of Fig. 7. Here resin regeneration would be carried out using purchased sulphuric acid and the resulting ammonium sulphate sold as fertilizer. New ammonia would be added through the lean $SO_2$ absorber and the resulting ammonium bisulphite solution would be pumped to the accumulator for use as pulping liquor. By this means, nearly all ionic ammonia would be recovered, and nearly all sulphur dioxide would be absorbed from stack gas into an alkaline solution and reused. Preliminary estimates of costs for this scheme are also shown in Tables IV and V.

None of the processes studied appears to be attractive economically.

Other similar ion exchange processes can be considered based on use of the sodium ion. These will show about the same behavior as the ammonium ion.

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# Infrared Drying of Paper

R. L. BHARGAVA and J. H. ROBERTSON

**The newly developed General Electric quartz tube tungsten filament lamp of high wattage output represents a safe, controllable and compact method of using infrared drying on papermaking and converting equipment. It was concluded that heating by means of these G.E. lamps represents an additional cost of 40 to 100% over heating by means of conventional steam driers. However, due to relatively low capital cost of the infrared equipment and its installation, the main value of this type of heating would be in increased production on paper machines where driers cannot be installed due to space limitations. A short description and evaluation of infrared drying on paper machines is given. Other tests conducted in the laboratory and the data obtained are examined.**

The subject of this paper is one which has enjoyed a considerable amount of publicity during the past few years and one which is beginning to have a wide range of influence in the paper industry. Despite the relatively high cost of energy, infrared is being accepted as a production tool on account of convenience, ease of application, and lower capital cost.

The chief characteristic differentiating infrared heating from the more usual methods of transferring heat by conduction and convection is that whereas with the latter methods contact is necessary between the heating medium and the material to be heated, with radiant heating it is unnecessary. Instead, energy is emitted by the source and travels unchanged through space in the form of electromagnetic radiation. When these radiations encounter an obstruction some of the energy will be absorbed within the substance of the obstruction, some will pass through it and emerge as thermal radiations, and some may be reflected back from the surface. Thus the quantity of heat respectively absorbed, transmitted, and reflected depends upon the nature of the substance and the wavelength of the thermal radiation. Infrared radiation is considered to be that portion of the electromagnetic spectrum which lies above the visible red, i.e., above 0.7 mu wavelength. Any body can be used as a source but the quality of the radiation or wavelength distribution and its rate of emission depends on the nature of the body and its temperature; the higher the temperature the shorter is the wavelength, the greater the rate of emission. With the rise of temperature the maximum of wavelength distribution curve becomes closer to the visible range of the spectrum and accordingly there is a decrease in wavelength.

When an article is heated by radiation the temperature rises initially at a rate dependent on its absorptive power, surface area, heat capacity, and on the intensity of the radiation. As the article gets hotter the rate of heat loss from its surface increases and its temperature rises more slowly until it ultimately becomes steady at a figure at which the input by radiation balances the loss. Different materials have different absorption characteristics for the infrared, and therefore will behave differently when exposed to these radiations. For shorter wavelengths many plastics have 100% transmission but show strong absorption or low transmission for longer wavelengths. In fact in the invisible region of the electromagnetic spectrum, i.e., in the far infrared region above 3 mu wavelength, practically all solids and liquids are opaque. One of the most important factors in favor of infrared heating is that radiation falling on an opaque body is immediately transformed into heat and it is heated above the surrounding ambient.

For efficient heating by radiation it is necessary to match the infrared absorption spectrum of the material with the infrared radiation. This is because only that portion of the infrared rays absorbed by the material is useful which falls in the region of absorption spectrum of the material. A 1-mm. film of water first starts to absorb strongly at 1.4 mu and it is shown by Broughton (*1*) that about 60% of the energy from a high temperature source, i.e., in lower wavelength region, should be absorbed while close to 100% of the radiation from the low temperature source at 700°F. will be absorbed.

It is quite obvious that infrared drying should be applied when the paper web still contains a lot of moisture, in order to make the best use of available energy. Experiments were conducted at Howard Smith Paper Mills using a new type of infrared tube developed by the General Electric Co. The installation consisted of six lamps, each 25 in. in lighted length, set in two rows of three across the width of the paper machine, immediately before the smoother press. The installation of lamps is illustrated in Figs. 1 and 2. The total length of lighted area across the machine was, therefore, 75 in. The rows of lights were mounted in the same reflector and were three-fourths of an inch apart. The height of lamps above the paper was such that the area of paper under radiation was 450 sq. in.

Operating at 550 v. each lamp was rated at 2500

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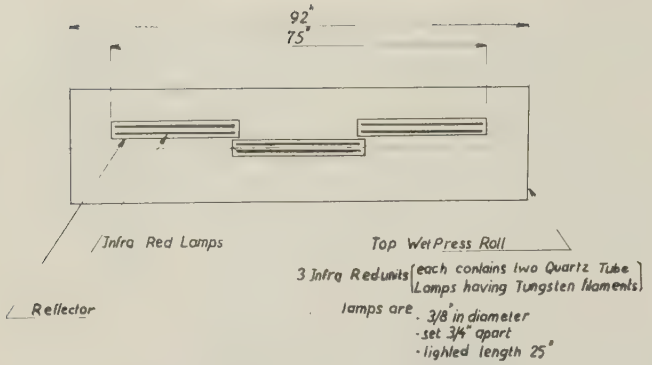
92"
75"
Infra Red Lamps
Top Wet Press Roll
3 Infra Red units (each contains two Quartz Tube Lamps having Tungsten filaments)
Reflector
lamps are . 3/8" in diameter
- set 3/4" apart
- lighted length 25"

*Fig. 1. Infrared units installation; top view*

watts, therefore, the total output from the six lamps was 150,000 watts, or 20 hp. This is equivalent to 848.2 B.t.u. per min. The color temperature of the lamps was approximately 2500°K.

Several measurements were made to determine whether or not the lamps located at the above position resulted in a reduction of moisture content of the paper and it was found that no significant drying of paper took place. These results were not too surprising since a considerable quantity of heat was required to heat the water in the paper up to a temperature at which evaporation will take place.

It may be mentioned that in this preliminary evaluation of infrared drying the temperature of paper was measured by an alcohol thermometer and as such the measurements are only approximate. For accurate measurements a more elaborate apparatus will be necessary.

**Table I. Effect of Infrared Lamps Upon Temperature of the Paper When Lamps Were Installed After the 2nd Wet Press**

| *Basis weight (22 × 34—500), lb.* | *Speed, f.p.m.* | *Date* | *Temperature of the paper web, °F. Before infrared lamps* | *After infrared lamps* | *After smoothing press rolls* | *After 1st steam drum drier* |
|---|---|---|---|---|---|---|
| 39 | 535 | May 21 11:00 a.m. | 69.8 | 75.0 | 75 | 122 |
| 39 | 535 | May 21 3:20 p.m. | 68.5 | 75.5 | 86 | 230 |
| 39 | 535 | May 21 4:00 p.m. | 68.5 | 80.0 | 86.5 | ... |
| 47¾ | 535 | May 22 | 71.0 | 80.0 | 86.5 | 128 |
| 41 | 410 | May 22 | 69.5 | 80.0 | 85.5 | 130 |
| 41 | 435 | May 22 | 69.5 | 80.0 | 86.5 | 130 |

Measurements were then made of the paper temperature before and after the infrared lamps and after the first steam-drum-drier. These data are given in Table I and show that the lamps resulted in a temperature increase ranging from 5 to 11°F. on paper having a temperature of approximately 69°F. and a moisture content of around 71%.

Soon after switching on the infrared lamps the first set of readings were taken and the temperature increase was found to be 5.2°F. as shown in Table I, whereas the tests made after 7 hr. of operation showed a total increase of 12.5°F. after smoothing press rolls, as shown in Table II. On checking it was found that the additional heat was coming from parts of the paper machine which had gradually been absorbing heat from infrared radiation. The rise in temperature of paper immediately after the second press and infrared dryer was 6°F., while the balance of 6.5°F. was due to absorption of energy by smoother rolls, etc.

**Table II**

| | *Actual temperature, °F.* | *Temperature difference, °F.* |
|---|---|---|
| Before the 2nd wet press | 69.5 | ... |
| After the 2nd press but with the infrared lights off | 74 | 4.5 |
| After the 2nd press but with the infrared lights on | 80 | 6 |
| After the smoothing press rolls | 86.5 | 6.5 |

**Table III. Number of Infrared Units (6 Lamps) Equivalent to the Average of One Steam Drum Drier**

Production of paper at 5% moisture content = 2565 lb./hr.
Moisture content of paper entering driers = 69.2%
∴ Pounds of water evaporated per pound of paper at 5% = 2.19 lb.
Weight of water evaporated for 2565 lb. paper = 5617 lb.
B.t.u. of heat required to evaporate water from paper =

$$[A \times (t_1 - t)] + [A \times L] + [B \times (t_2 - t) \times S]$$

where

$A$ = weight of water evaporated, lb.
$t$ = temperature of paper into dryers, °F.
$t_1$ = temperature of paper at which water evaporated, °F.
$B$ = weight of paper at 5% moisture, lb.
$t_2$ = maximum temperature of the 5% paper during drying, °F.
$L$ = latent heat of vaporization, B.t.u./lb. water
$S$ = specific heat, which for paper is 0.45

B.t.u. required = $[5617 \times (180 - 70)] + [5617 \times 970] + [2565 \times (200 - 70) \times 0.45]$
= 6,218,000 B.t.u./hr.
2545 B.t.u. = 1 hp-hr.
6,218,000 B.t.u. = $\frac{1}{2545} \times 6{,}218{,}000 = 2450$ hp-hr.
Number of steam drum driers used = 32
∴ Useful horsepower required per drier = 76.4 h.p.-hr.
Output of the infrared unit (6 lamps) = 20 h.p.-hr.
Estimated efficiency of absorption of infrared unit = 71%
∴ Useful horsepower = $20 \times \frac{71}{100} = 14.2$ hp.-hr.
∴ Number of infrared units required to equal the average drying capacity of one steam drum drier = $\frac{76.4}{14.2} = 5.4$ units

Using the above temperature measurements made while running a paper of 41 lb. (22 × 24—500) basis weight and a speed of 410 f.p.m., the efficiency of the lamps was calculated to be 71%. From the cost standpoint heating by infrared was approximately twice as great as heating by steam and even at 100% efficiency it would be 40% greater.

Similarly, the calculations were made to determine how many of the six lamp infrared units would be required to equal the drying capacity of one steam drum

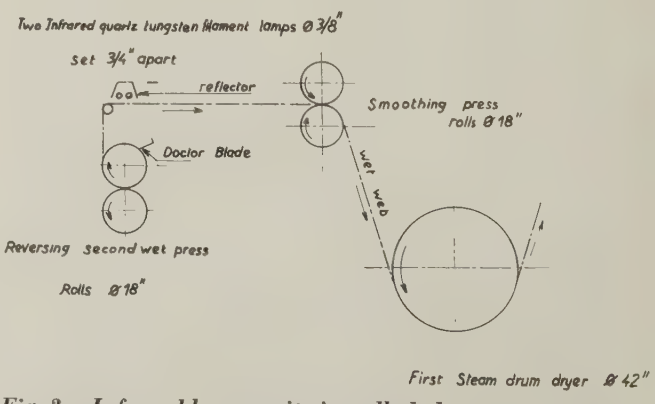
Two Infrared quartz tungsten filament lamps Ø 3/8"
set 3/4" apart
reflector
Smoothing press rolls Ø 18"
Doctor Blade
Wet web
Reversing second wet press Rolls Ø 18"
First Steam drum dryer Ø 42"

*Fig. 2. Infrared lamp units installed above second reversing wet press*

**Table IV. Per Cent Moisture Content of Papers Having Various Initial Moisture Contents After Exposure to Infrared for 10 Sec.**

| *Test no.* | *Initial moisture content of the paper before exposure to infrared, %* | *Final moisture content of the paper after exposure to infrared for 10 sec., %* | *Pounds of water per pound of paper solids* |
|---|---|---|---|
| 1 | 72.6 | 71.5 | 0.17 |
| 2 | 72.5 | 66.0 | 0.69 |
| 3 | 66.8 | 56.0 | 0.74 |
| 4 | 42.0 | 37.6 | 0.12 |
| 5 | 42.0 | 33.5 | 0.22 |
| 6 | 18.7 | 0 | 0.23 |
| 7 | 17.2 | 0 | 0.21 |

drier. The calculations are shown in Table III. The useful horsepower required per drier was calculated to be equal to 76.4 hp. per min. while the output of one unit or six infrared lamps was 20 hp. per min. The estimated efficiency of absorption of infrared unit being 71%, the number of infrared units required to equal the average drying capacity of one steam drier was 5.4. In other words, 5.4 banks of infrared units will be required to replace one steam drum drier.

It is evident from this that infrared heating would only be used due to much lower initial capital expenditure or when additional steam drum driers cannot be installed.

## LABORATORY INVESTIGATION

As need is felt for noncontact drying and the radiation technique comes up for consideration there are always the questions of what radiant intensity, what time of exposure, what distance, etc., will produce what results. Such questions cannot be readily answered on a paper machine under operation. For this reason laboratory evaluations of radiant drying were carried out.

One of the three lamps was taken apart and fixed in an asbestos board cabinet in such a way that the lamp could be raised or lowered as desired and that a wire gauze table could be slid under the lamp through a slit. The wet paper could be spread over the table and pushed under the lamp when desired. The pulp sheets used during the investigation were taken from the wet broke after the first press. The pulp had an average moisture content of 73.5%.

It was observed that when the distance between the

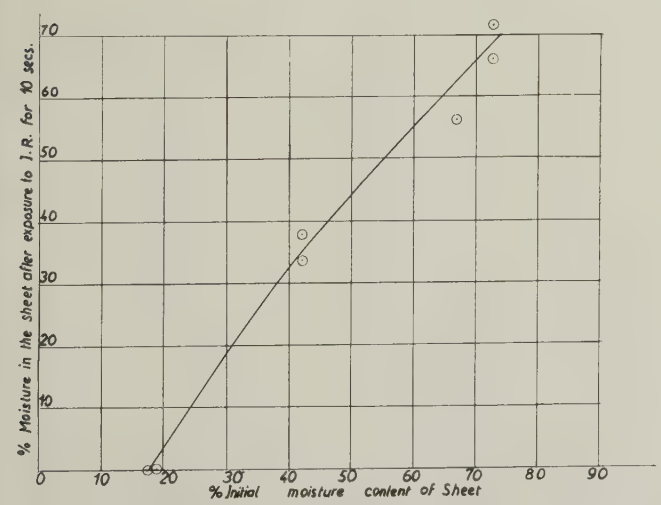


*Fig. 3. Per cent moisture retained in sheet after exposing the sheets (containing varying amounts of moisture initially) to infrared 10 sec.*

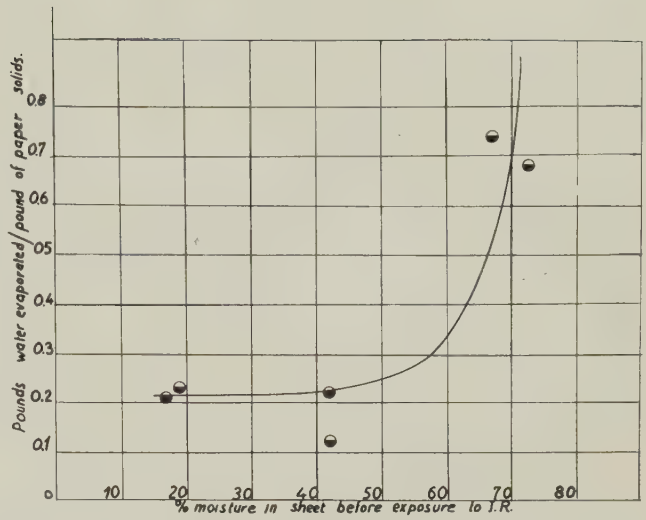


*Fig. 4. Water removal versus initial moisture content of the paper exposure time to infrared = 40 sec.*

lamp and pulp sheet was 3 in., an exposure of 10 sec. was enough to bring the paper to the ignition point. Hence, in order to have ease in carrying out the experiments it was thought desirable to increase the distance between the source of radiation and paper to 10 in. throughout the experiments. The actual distance, while the lamps were operating on the paper machine, was about 3 in., thus the radiation conditions at the stationary stage were comparatively much less intense.

The following sets of experiments were carried out.

1. Sheets of varying moisture contents were exposed to infrared radiation for a constant length of time (10 sec.) and the moisture content was determined in each case. The data obtained are shown in Table IV and Figs. 3 and 4. It is seen that the higher the moisture content of the paper, the more efficient was the removal of water by the infrared heating. For example, after 10 sec. exposure a paper having an initial moisture of 18.7% lost 0.23 lb. water per pound of paper while under similar exposure conditions a paper having an initial moisture content of 66.8% lost 0.74 lb. of water per pound of paper.

2. Sheets of constant moisture content were exposed for varying lengths of time to infrared radiation and the moisture content was noted in each case. These data are shown in Table V and Fig. 5. The shape of the drying curve suggests that the efficiency of drying papers in the lower moisture ranges of approximately 15% down to 5% moisture does not drop off as rapidly when using infrared as the heating source as when using steam. To illustrate this point the moisture content of the paper as it passed over the steam drum driers of the paper machine was determined at a number of points and these values are given in Table VI and plotted versus time of

**Table V. Reduction in Paper Moisture Content Versus Time of Exposure to Infrared Radiation**

| *Time of exposure to infrared lamps, sec.* | *Moisture content of paper after exposure, %* | *Water evaporated per pound of paper solids, lb.* |
|---|---|---|
| 0 | 73.5 | 0 |
| 5 | 71 | 0.33 |
| 10 | 69 | 0.56 |
| 20 | 64 | 1.00 |
| 25 | 60 | 1.28 |
| 30 | 48 | 1.85 |
| 40 | 21 | 2.51 |
| 50 | 0 | 2.78 |

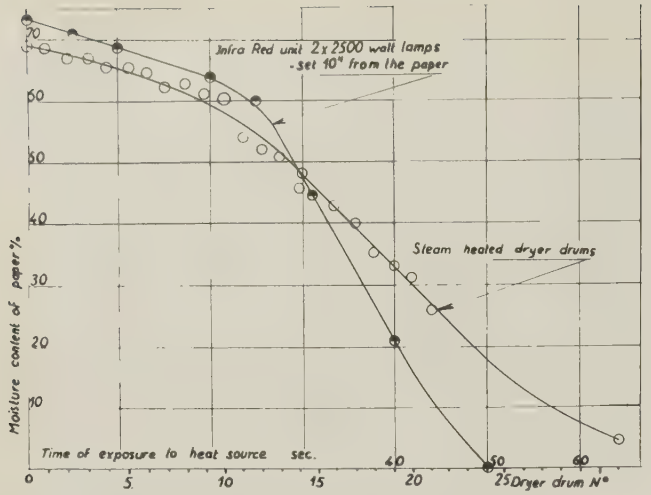
Infra Red unit 2x2500 watt lamps
-set 10" from the paper
Steam heated dryer drums
Moisture content of paper %
Time of exposure to heat source sec.
Dryer drum N°

*Fig. 5. Reduction in moisture content of the paper versus time of exposure to heat source*

drying in seconds as shown in Figs. 5 and 6. The marked change in slope or reduction in evaporating rate as the sheet becomes drier should be noted.

This same comparison is shown in Fig. 6; the loss in moisture is shown as pounds of water evaporated per pound of paper solids versus drying time.

3. Three layers of wet sheets each of the same moisture content were exposed to infrared radiation for varying lengths of time and the moisture content of each layer was separately determined. The results are shown in Table VII and Fig. 7. During this series of experiments it was found that the only moisture removal which took place during the various periods of exposure to infrared was from the top layer; the two layers underneath were little affected except at long exposure times of 60 sec. Therefore, nearly all of the infrared radiation is either absorbed or reflected by the white top surface of the paper.

The wavelength distribution of the infrared radiations match to a large extent with the infrared absorption spectrum of water which is present in the paper. This is important, because only that portion of the rays is converted into useful heat which falls under the infrared absorption spectrum of water.

4. The distance between the infrared source and wet paper was varied between 6 and 17 in. and the exposure time was kept constant to 10 sec. The moisture contents of the exposed sheets were subsequently deter-

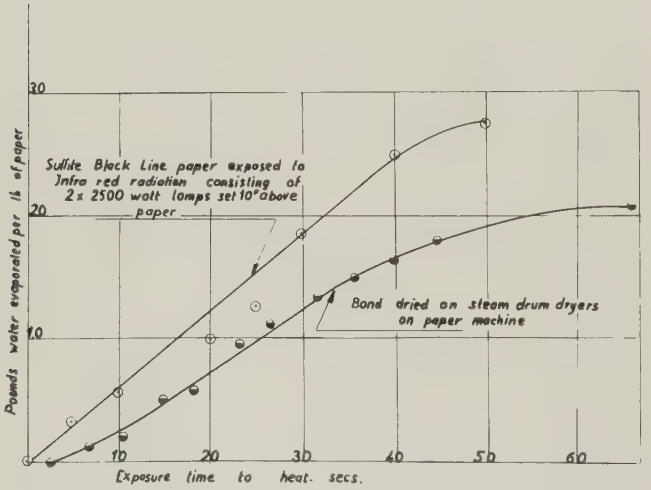
Sulfite Black Line paper exposed to
Infra red radiation consisting of
2 x 2500 watt lamps set 10" above
paper
Bond dried on steam drum dryers
on paper machine
Pounds water evaporated per lb of paper
Exposure time to heat. secs.

*Fig. 6. Water evaporation versus time of exposure to heat*

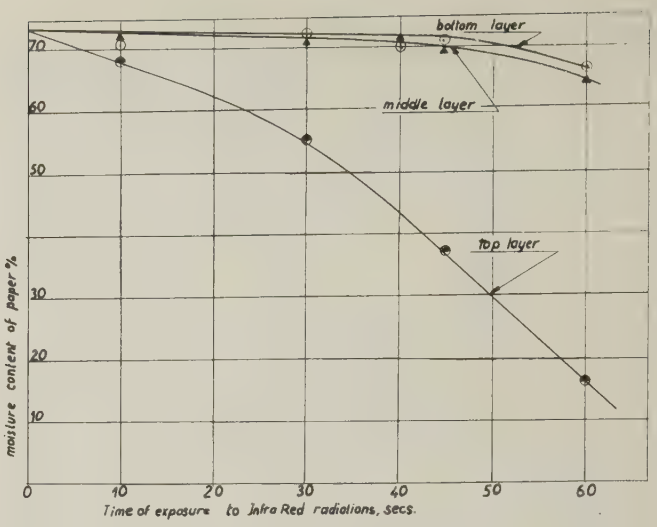


*Fig. 7. Absorption of infrared energy versus exposure time into 3 layers of paper. Each having an initial moisture content of 73.5%. The infrared unit was 10 in. above the top layer of paper*

mined. The results are shown in Table VIII and Fig. 8. When distance between the source of infrared and paper was varied it was observed that the moisture evaporation rate decreased as the distance was increased, particularly with distances greater than 11.5 in.

5. Dry sheets were dipped in starch as well as in glue solutions (5 sec. immersion time) and their moisture contents were determined. These saturated sheets were exposed to infrared radiation at various lengths of time and the moisture content in each case was subsequently determined. The results are shown in Table IX and Fig. 9. These experiments showed that the starch size press coated paper containing 18.5% moisture, required only 5 sec. exposure to infrared radiation consisting of two lamps, each 2500 watts, set at a distance of 10 in.

**Table VI. Moisture Content of Paper Samples Taken at Various Points Along the First Drier Section of the Paper Machine**

Number of driers in the first section = 32 (42-in. diam.). The paper had a basis weight of 48 lb. (22 × 34—500), running speed of 200 f.p.m. and a deckle of 67 in. The production was 1235 lb. per hr. at a moisture content of 4.5%. The time of contact of the paper on each drier was calculated to be 2.1 sec. It was estimated that the paper contacted 7 ft. of the 11-ft. circumference of the drum

| *Drier no.* | *Contact time, sec.* | *Paper moisture, %* | *Pounds water evaporated per pound of paper solids, m.f., lb.* |
|---|---|---|---|
| Before drier | 0 | 68.7 | 0 |
| 1 | 2.1 | 68.7 | 0 |
| 2 | 4.2 | 67.0 | |
| 3 | 6.3 | 67.1 | 0.12 |
| 4 | 8.4 | 65.2 | |
| 5 | 10.5 | 66.0 | 0.22 |
| 6 | 12.6 | 64.9 | |
| 7 | 14.7 | 62.2 | 0.51 |
| 8 | 16.8 | 63.1 | |
| 9 | 18.9 | 61.1 | 0.59 |
| 10 | 21.0 | 60.2 | |
| 11 | 23.1 | 54.1 | 0.98 |
| 12 | 25.2 | 52.3 | |
| 13 | 27.3 | 50.6 | 1.14 |
| 14 | 29.4 | 46.0 | |
| 15 | 31.5 | 44.8 | 1.35 |
| 16 | 33.6 | 42.8 | |
| 17 | 35.7 | 39.6 | 1.50 |
| 18 | 37.8 | 35.2 | |
| 19 | 39.9 | 33.0 | 1.67 |
| 20 | 42.0 | 31.2 | |
| 21 | 44.1 | 26.0 | 1.81 |
| 32 | 67.2 | 4.5 | 2.11 |

**Table VII. Absorbency of the Infrared Rays into Three Layers of Wet Paper Sheets Having an Initial Moisture Content of 73.5%**

| *Time of infra-red exposure, sec.* | *Moisture content of top layer, %* | *Paper after exposure to infrared Middle layer, %* | *Bottom layer, %* |
|---|---|---|---|
| 0 | 73.5 | 73.5 | 73.5 |
| 10 | 68.0 | 72.5 | 71.0 |
| 30 | 55.3 | 70.6 | 71.9 |
| 40 | 39.0 | 71.0 | 70.5 |
| 45 | 37.2 | 69.6 | 71.1 |
| 60 | 16.7 | 64.8 | 66.5 |

*Note:* There is no appreciable loss of moisture from the second and third layers of paper until the top layer had been exposed to the infrared radiation for 45 sec. and the moisture content had been reduced to 37.2%.

from the paper. Similar paper sized with glue solution and containing 15.1% moisture required 15 sec. in order to dry it. Evidently, the starch has faster water release properties than the glue.

## GENERAL CONCLUSIONS

Due to possible inaccuracies in measuring the paper temperature by pressing a glass thermometer against the paper web and also due to the fact that the infrared unit only had sufficient output to increase the temperature of the paper a few degrees and without effecting any water evaporation, it is difficult to calculate with any degree of certainty the actual efficiency of this trial unit. From an operating standpoint the power cost of drying using infrared would be approximately twice as great as the steam cost using conventional steam drum driers.

**Table VIII. Rate of Water Evaporation Versus Distance of Infrared Lamps Above the Paper**

Time of infra-red exposure was constant at 10 sec. The initial moisture content of the paper was 72.1% or 2.59 lb. of water per pound of paper solids

| *Distance between infrared unit and paper, in.* | *Moisture content of paper after 10 sec. exposure, %* | *Pounds of water evaporated per pound paper solids per 10 sec., lb.* |
|---|---|---|
| 5.75 | 65.5 | 0.69 |
| 8.60 | 68.5 | 0.42 |
| 11.50 | 70.9 | 0.15 |
| 14.35 | 71.5 | 0.09 |
| 17.20 | 71.8 | 0.05 |

*Note:* As the distance between the infrared source and the paper was increased from 5.75 up to 17.2 in., there was a gradual decrease in rate of water evaporation from 0.69 down to 0.05 lb. of water per pound of paper solids, respectively, for 10 sec. exposure time. This, of course, would be expected since the intensity of radiation per square inch of paper would decrease from approximately 1.48 B.t.u. per minute at 5.75 in. to 0.43 B.t.u. per minute at 17.20 inches.

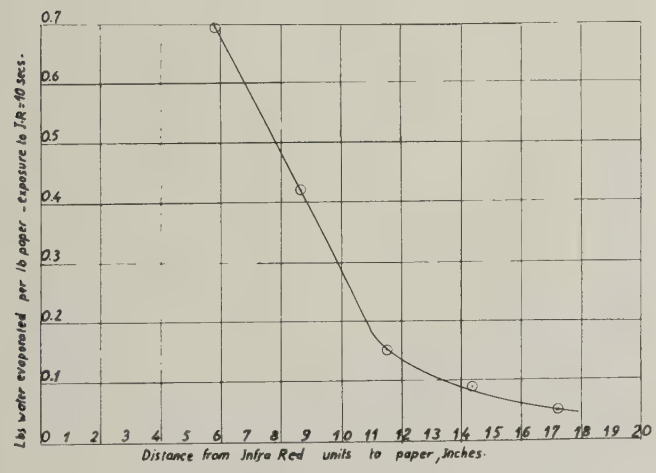
Lbs water evaporated per lb paper - exposure to IR=10 secs.
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Distance from Infra Red units to paper, inches

***Fig. 8. Rate of water evaporation versus distance of infrared lamps above the paper. Time of infrared exposure was constant at 10 sec. The initial moisture content of the sulphite block line paper was 72.1% or 2.59 lb water/lb of paper solids***

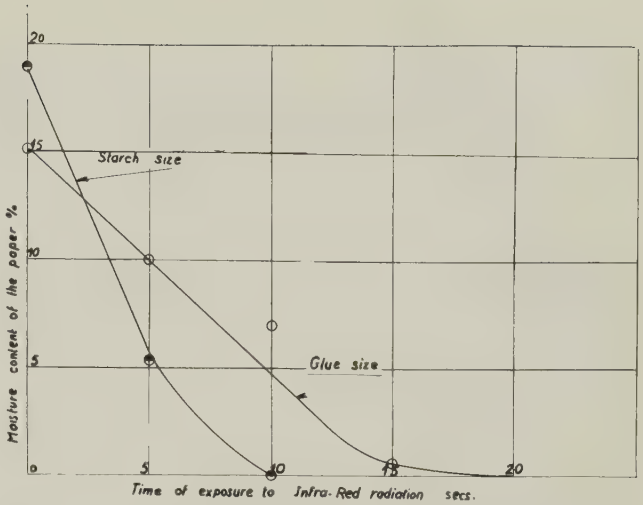


***Fig. 9. Drying of papers impregnated with starch and glue size-press solutions when exposed to infrared radiation. Distance between infrared unit and paper was 10 in. The paper base used was: sulphite black line***

It is estimated that approximately five to six of the six-lamp units would be required to give comparable paper drying to one 42-in. diam. drying drum operating at approximately 30 p.s.i. steam pressure.

It is well known that the efficiency of drying using steam drum driers drops off rapidly when the paper reaches a moisture content of less than 15%. It is possible that the drop off in efficiency with the infrared units would not be nearly so great in this moisture range and, therefore, the number of units required to equal one drier would be much less.

**Table IX. Rate of Drying of Papers Impregnated with Starch and Glue Size Press Solutions When Exposed to Infrared Radiation**

Distance between infrared unit and paper was 10 in. Basis weight of paper (22 × 34—500) = 41 lb.

| *Time of expsoure to infrared radiation, sec.* | *Starch tub sized final moisture content, %* | *Glue tub sized final moisture content, %* |
|---|---|---|
| 0 | 18.5 | 15.1 |
| 5 | 5.5 | 10.0 |
| 10 | 0 | 6.9 |
| 15 | 0 | 0.6 |
| 20 | 0 | 0 |

*Note:* The paper tub sized with starch required only 5 sec. drying time to bring it to a moisture content of 5.5% whereas the paper tub sized with glue required 10 sec. exposure to bring it to 6.9%. This indicates that the water release from starch is much faster than from glue.

The infrared units are compact and, therefore, they would be of great value where additional drying was required but due to space limitations additional steam drum driers could not be installed. In addition, due to the low capital cost of the infrared units, they could be installed on a paper machine where additional drying was only required when certain grades were being run. We found that the use of infrared lamps was practical, controllable, shockproof and capable of delivering radiations at high intensity. They afford a low-cost means of speeding up existing operations.

## LITERATURE CITED

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Presented at the Thirteenth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Portland, Ore., July 28–Aug. 1, 1958.

# A Slurry System for Saltcake Distribution

O. J. BRISTOW, J. J. OWEN, Jr., and J. J. YIRAK

**After considerable laboratory and mill experimentation, a hydraulic system has been designed and built for distributing saltcake from the main storage area to the various recovery units at the Savannah mill of Union Bag-Camp Paper Corp. Using automatic control of a batch process, saltcake is mixed with weak black liquor to a high solids content in a mixing tank located at the storage area. The resulting slurry is pumped through a circulating header passing through the recovery room, and at each recovery unit the required amount of saltcake is withdrawn by a small metering pump and fed to the furnace. No separate operator is required for the system, with saltcake addition to all units being controlled from a single location. A great deal of attention to engineering details and equipment selection was required to produce a satisfactory system since provision had to be made for each of the many possible sources of difficulty. The result, however, has been a system which is cleaner, easier to operate, capable of closer control, and less demanding of maintenance than the mechanical system it replaced.**

In any kraft pulp mill, there are always certain problems associated with the handling of the saltcake supplied the recovery furnace as make-up chemical. These stem from the severe dusting of some saltcakes, the caking and acidity of others, and the lack of a uniform particle size of most. As the size of a kraft pulp mill increases, the number of its individual recovery units increases, and saltcake handling and distribution problems become more acute. Finally, the point is reached where conventional systems become so troublesome as to warrant giving serious attention to the design of a completely new type of saltcake distribution system that will reduce the difficulties encountered in the continuous distribution of large quantities of saltcake to a number of points.

This was the situation at the Savannah, Ga., mill of the Union Bag-Camp Paper Corp. in early 1955. As a result of a series of expansions over a period of more than 15 years, the mill was operating a total of 11 recovery furnaces to which saltcake was distributed by a mechanical system. The system consisted of a series of drag and screw conveyors and bucket elevators which had been extended with each expansion, and had become extremely long and complex as well as overloaded and antiquated. Consequently, when it was decided to install the twelfth recovery unit, a completely new saltcake distribution system was included. Since the existing mechanical system had required excessive maintenance and caused much difficulty for a number of years, considerable thought and effort went into the selection and design of the new system.

## SYSTEMS CONSIDERED

Three basic types of systems were considered for the new installation: mechanical, pneumatic, and hydraulic. In order to simplify the problem, it was decided to supply saltcake to only the five largest recovery furnaces, which were located furthest from the saltcake storage area. This was possible because the other seven furnaces were quite small, and many of them would have to be replaced in any future expansion of the mill. There was still the problem of conveying an average of 100 tons per day of saltcake a long distance from the unloading and storage area, and distributing it to five widely separated points. The mechanical system could definitely be used, but it had many undesirable features. The pneumatic system was being used in similar situations, but experience with it was somewhat limited. The hydraulic system was almost unknown in such service.

A layout for a mechanical system was made, including drag link conveyors, screw conveyors, a bucket elevator, and storage bins at each recovery furnace. It was obvious that the length and complexity of this system would make it subject to frequent mechanical failure with resulting high maintenance costs. Such a system, even though enclosed, would have a tendency to leak dust, which would increase through the years. This dust leakage was considered to be a serious drawback for several reasons in addition to the actual value of the dust. It would make it difficult to keep the area clean, and would mean very unsatisfactory working conditions for the personnel in the recovery room. Also, since much of the saltcake used would be acidic on receipt, the dust would have a decided effect in increasing the corrosion of the steel and concrete over a large area. Because of the varying bulk and density of saltcake, in any mechanical system it would be difficult to measure and control the quantity fed to a given point.

A pneumatic system would be subject to possible plugging and to leakage in the ductwork and at the cyclones at each individual recovery furnace, with the dust causing the same problems as previously mentioned. There was also the problem of recovering the dust from a number of widely separated cyclones. Since the feed to the furnace would have had to be from a storage bin at each location, control problems would be the same as with the mechanical system. Further, since only one of the five points could be supplied at one time, there was considerable concern over the size of storage bin that would have to be installed at each furnace to ensure an adequate supply of saltcake at all times.

If the hydraulic system were practical, it would overcome many of the undesirable features of both the mechanical and pneumatic systems. There would be no problem of dust leakage with its attendant troubles, and there was the promise of very precise control of the quantity of saltcake fed to each point in the system. The hydraulic transport of many solid materials over long distances from one point to another was relatively common, but multipoint distribution was not being

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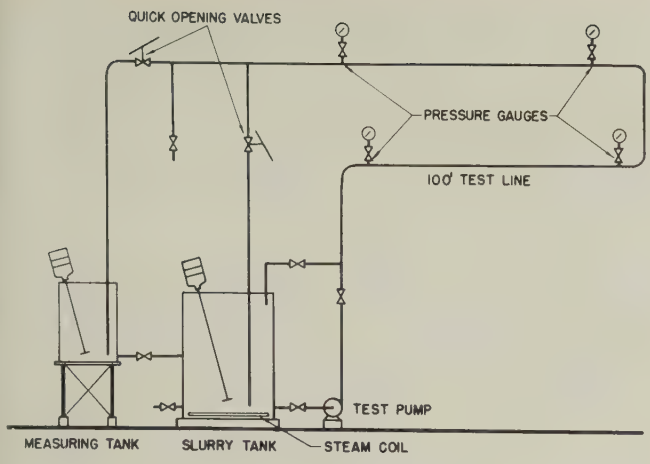


*Fig. 1. Apparatus for evaluating saltcake slurry properties*

used to our knowledge. At least two pulp mills were adding their saltcake make-up to all their heavy black liquor at a central point and distributing it to two or three recovery furnaces. This, of course, was nothing like the distribution system needed in our mill. It was hoped that saltcake could be dispersed in water, weak liquor, or heavy liquor to form a slurry which could be distributed in measured quantities to each recovery furnace. The major drawback to such a system would be the steam loss brought about by the extra water put into the furnace. Thus it appeared that considerable experimental work would be required in both the laboratory and pilot plant stages to determine the feasibility of such a system.

## EXPERIMENTAL

The first step was a small amount of laboratory work to determine whether the idea was at all possible. Since the liquid carrier would either be water, or a mill liquor containing water, that would enter the recovery furnaces, it was necessary to know the amount of water involved and the magnitude of the consequent added heat load on the furnaces. Various types of saltcake were slurried in water, weak black liquor (evaporator feed liquor), and strong black liquor, to various total solids contents. It was found that weak liquor was most suitable. It was capable of carrying nearly as much saltcake in suspension as water and since a portion of its water content must enter the recovery furnace anyway, its use appeared most economical. Water was also unsuitable because of the possibility of recrystallization and solidification with varying temperatures. Strong black liquor was unsuitable as a carrier because of its high viscosity at the temperatures which would exist during slurrying.

It was found that slurries in weak black liquor with total solids contents as high as 65% remained fluid and, with sufficient agitation, appeared capable of being pumped. It was calculated that the additional water added to the recovery furnaces with such a slurry would result in less than a 1% increase in heat load. While these results were somewhat encouraging, other fundamental questions remained to be answered before an attempt could be made to design a system. Knowledge was required of the effect of the slurry on furnace operation, and a general idea was needed of whether the slurry could be satisfactorily pumped and what velocity, particle size, and pipe size would be required.

In order to gain this additional, but still preliminary, information a trial was made in the mill. An existing mixing tank with a slow speed agitator and conventional centrifugal pump was fitted with a long run of standard threaded 2-in. pipe which passed near one of the recovery furnaces, where a take-off was provided, and returned to the mixing tank. Slurries of saltcake in weak black liquor were made up to 65% total solids and circulated through the line back to the tank, taking off a portion of the flow for addition to the recovery furnace at the normal point of addition, the furnace saltcake mixing tank. The slurry was added to the furnace at a rate considerably above the normal saltcake addition rate without any detrimental effect on furnace operation. The makeshift system used for the trial pointed out some problems to be overcome, however, if a mill-wide system were to be designed. The slow speed agitator, while providing considerable agitation, was far from adequate and settling of the coarser saltcake particles occurred, causing plugging at the pump suction. The circulating line, with many standard threaded elbows, plugged repeatedly as the velocity fluctuated.

It was clear that further data were needed in order to design a mill-wide system, and, since furnace operation was no longer a factor, it was decided to gain the necessary hydraulic and equipment information in a small pilot plant, and then proceed with designing and building the system. To get the necessary design information the pilot scale system shown in Fig. 1 was constructed. The following factors were then studied: pressure drop-velocity relationship, minimum velocity required to prevent plugging, effect of particle size,

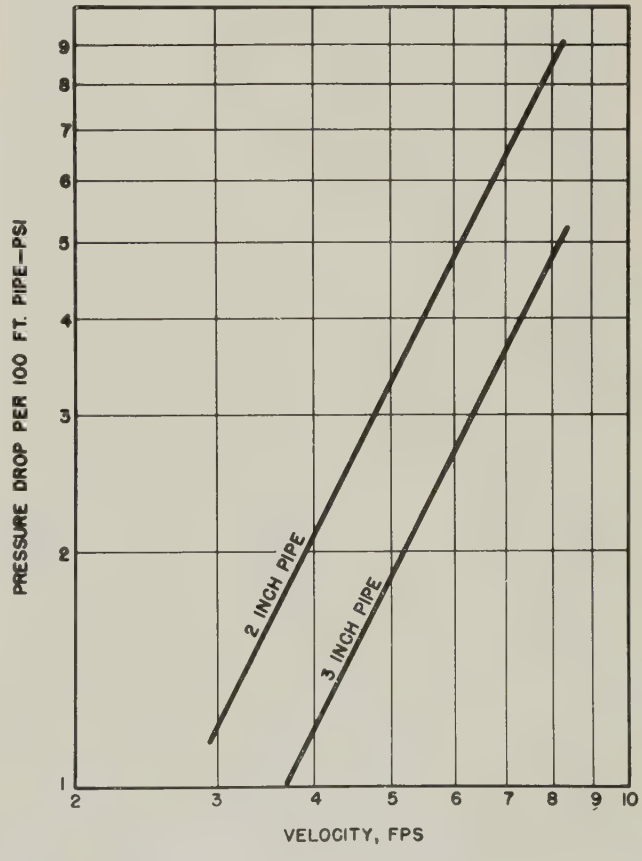


*Fig. 2. Velocity versus pressure drop, saltcake—weak black liquor slurry in standard steel pipe*

effect of saltcake type, performance of various pumps, effect of solids concentration, pressure drops in fittings, agitation requirements, and performance of conventional valves.

It was found that the slurry at 65% solids, when kept in rapid movement, behaved hydraulically much as any dense liquid. No difficulties were experienced in pumping it with either positive displacement (gear) or centrifugal pumps under normal conditions. Pressure drop in pipes varied with velocity according to accepted theory. A plot of pressure drop versus velocity for two pipe sizes is given in Fig. 2. The pressure drop in pipe at a given velocity is about a third higher than for water. Pressure drops in standard elbows are nearly twice as high as for water. It was found that keeping the slurry in rapid movement was essential to prevent plugging of pump suctions and pipe lines, and minimum agitation and velocity requirements were established for the mill system. With these requirements met, all commercial saltcakes available to the mill could be handled, with only a minor crushing to remove the large lumps caused by caking, although their particle size distributions varied considerably.

A number of important difficulties were encountered with the pilot plant. It was found, for example, that by-product saltcake from acid manufacture (containing free acid) caused the evolution of hydrogen sulphide from the slurrying liquor, resulting in foam and a poisonous gas hazard. Slurries from acid saltcake have a low pH, less than 5, adding to the corrosion problem. Equipment problems were noted also, an example being the use of conventional gate valves for throttling the slurry flow. These plugged easily and jammed in position and were considered completely unsatisfactory. Knowledge of these and other details aided considerably in the design of the mill system.

## DESIGN OF SYSTEM

Having shown the practicability of pumping and handling a slurry of saltcake and weak black liquor, the next problem was the design of a mill-wide system based on the laboratory and pilot plant work. In general, the system selected was one in which dry crushed saltcake and weak black liquor are added simultaneously to a well agitated mixing tank, with the resulting slurry pumped through a header passing each of the five furnace saltcake mixing tanks with a return header to the main slurry tank to permit uninterrupted flow of the slurry in the header under all conditions. At each furnace a portion of the slurry is taken off and introduced into the furnace saltcake mixing tank. The system is shown schematically in Fig. 3.

The maximum rate of saltcake consumption was established and this quantity proportioned to each of the five recovery units based on their respective sizes. These figures represented the maximum amount of saltcake which would be introduced at each recovery unit. The maximum rate of saltcake consumption was used as a basis for determining the size of the saltcake-black liquor mixing tank as well as the sizes of the saltcake and weak black liquor feeds. The size of the tank was designed to give adequate retention time for completely mixing the saltcake and black liquor and to provide a specified quantity of slurry that would be available to the recovery room when any

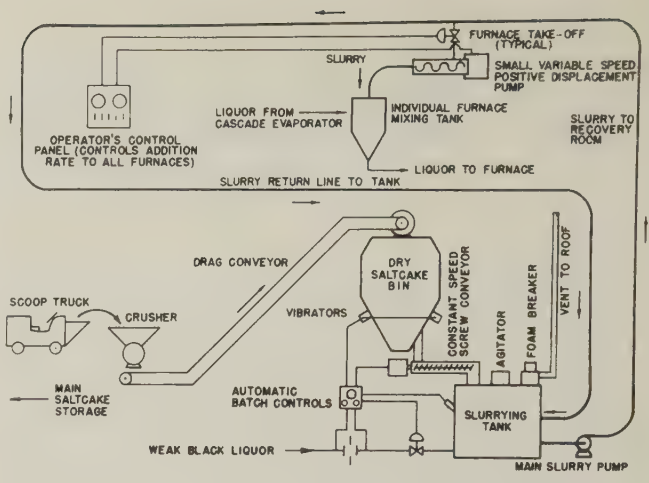


*Fig. 3. Saltcake distribution system*

part of the system up to the slurry tank was down for maintenance.

The sizes of the main supply and return headers and the main slurry pumps were also determined by the maximum saltcake consumption. Pilot plant work had indicated that there was a minimum velocity in the piping below which the slurry would settle out. Therefore, the flow of the slurry to the return header at times of maximum saltcake requirements had to be such that this minimum velocity was maintained. At the same time the size of the return header and the output head of the pump had to be sufficiently large to prevent a prohibitive pressure drop in the system when no saltcake was required in the recovery room.

Several methods of introducing the saltcake to the mixing tank were considered, and a screw conveyor was selected. Due to the inherent foaming, dusting, and evolution of hydrogen sulphide gas in this system, it was necessary to completely seal the main slurry tank, and the screw conveyor appeared to offer the simplest means of introducing dry material into a sealed tank. The weak black liquor is pumped into the bottom of the slurry to minimize foaming.

Considerable thought was given to the method of regulating the ratio of black liquor and saltcake being added to the slurry tank. The use of a black liquor flow controller was readily indicated, but there was a question as to the type of drive for the screw feeder. A ratio controller operating a variable speed drive was a possibility but was rather expensive and there was some doubt as to whether or not the system required such control. A constant speed motor was finally selected for the screw feeder.

In operation a level controller maintains the level in the slurry tank within certain specified limits. When the level drops to a predetermined point the flow of black liquor is started automatically and controlled at a given rate. As soon as the black liquor begins to flow the saltcake screw feeder is started automatically. When the level in the slurry tank reaches a specified point, the flow of black liquor and the screw feeder stop automatically. Obviously, the ratio of black liquor to saltcake must be changed manually by resetting the black liquor flow controller. Actual operation has confirmed the belief that a ratio controller operating a variable speed drive on the screw conveyor is not re-

quired. The rates of saltcake and black liquor addition were designed so that they would be operated continuously whenever the maximum amount of saltcake was required in the recovery room.

The construction of the slurry tank offered several possibilities. Because of the low pH which was encountered with certain saltcakes, some type of corrosion protection was required. The high rate of agitation which was required to keep the slurry in suspension necessitated some type of erosion protection. A steel tank with a stainless steel flat cover and a concrete bottom and with acid brick lining throughout was the final selection. A vertical, top-entering, stainless steel, turbine-type agitator was installed in the slurry tank to provide agitation. In addition, a foam breaker was installed on the top of the tank to assist in handling the foam and to provide an exhaust for the poisonous hydrogen sulphide gas which was formed with acidic saltcakes.

The erosive characteristics of the slurry dictated the use of a centrifugal pump instead of a positive displacement pump for the main slurry pump. Rubber hose and rubber-lined steel pipe were considered for the main headers for erosion and corrosion protection, but the temperature of the black liquor, sometimes as high as 200°F., resulted in the final choice of stainless steel pipe. An all-welded piping system with long radius bends instead of elbows was employed. The main slurry pumps were also constructed of stainless steel.

The main problem in the design of the entire system was considered to be the means of taking off a portion of the slurry from the main header for each of the recovery units. Pilot plant work clearly indicated that gate valves were entirely unsatisfactory for throttling the flow of the slurry, and it was felt the same was true of all other types of valves. It was finally decided to use a screw-type positive displacement pump with a rubber stator and a high chromium steel rotor to regulate the flow of slurry. A study of the capacities of these pumps at various speeds indicated that sufficient over-all flexibility in the rate of saltcake addition to the recovery room could be obtained by driving each of these positive displacement pumps with a four-speed motor. By means of these four-speed motors, with all pushbuttons mounted on a central control panel, the operator can regulate the addition of saltcake to all recovery units.

Electrical interlocks were installed on the various motors at the slurrry tank to provide safety and protect against plugged lines. In order for the main slurry pumps to run, the agitator on the tank must be operating. Saltcake cannot be added unless the black liquor is flowing, and the black liquor cannot flow unless the foam breaker is running. An alarm sounds whenever the foam breaker, agitator, supply pumps, or individual positive displacement pumps are shut down. Other precautionary measures have been incorporated in the form of water and steam connections to thoroughly purge all lines and valves which are temporarily being placed out of service.

A minimum number of valves for off-on control were used in the system. Since pilot plant work indicated the undesirability of using gate valves, plug cocks were used throughout. At each recovery unit take-off, a cylinder operated plug cock is employed for remotely

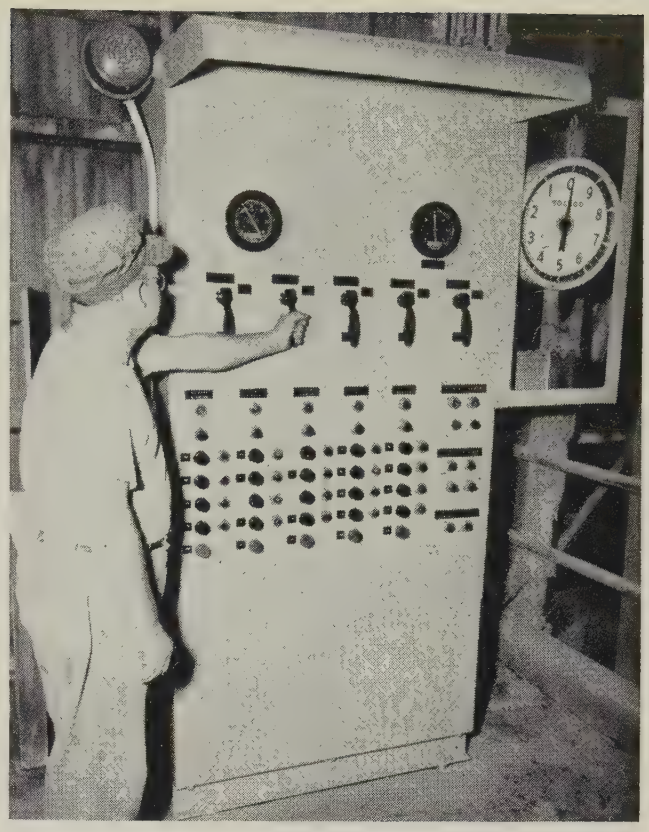

*Fig. 4. Operator's control panel*

starting or stopping the flow of slurry to the positive displacement pump from the central control panel.

## OPERATION OF SYSTEM

Saltcake is delivered to the mill in boxcars, unloaded with scoop trucks and mechanical conveyors, and stored in a large room. About once each 8-hr. shift the distribution system bin is filled with dry crushed saltcake. A scoop truck is used to transport the saltcake from the main storage area to the crusher feed conveyor a short distance away. This gives the flexibility required by the variable amount of saltcake in the large storage room. The saltcake is conveyed from the bin to the slurrying tank by the constant speed screw conveyor operated by the automatic batch controls. The automatic batch system discribed earlier requires little attention, consisting mostly of an occasional check of the recorders. The solids content of the slurry remains fairly constant and any change occurs slowly. The control test for the slurry consists of determining density by weighing a measured volume. A stainless steel bucket with a V-notch is used to take a constant volume sample which is weighed on a common butcher's scale. The apparatus is shown to the right of the control panel in Fig. 4. The test is made each hour by operating personnel, and when a change in density is detected the ratio of weak black liquor to saltcake is adjusted. In the range of operation the solids content is proportional to density and the simple test allows very good control. The total solids content is maintained at 60 to 65%.

Addition of the slurry to all recovery units is controlled from a single location on the operationg floor. The control panel is shown in Fig. 4. On the panel are gages showing the levels in the green liquor storage

tanks to aid the operator in estimating the amount of saltcake required. The amount of saltcake fed to each unit is varied by changing the speed of the individual metering pumps. Any or all of the units may be shut off completely from the panel by automatic valves. The entire saltcake system is operated by recovery unit operators; no separate operator is required. The system has been well received by operating personnel, who consider it a considerable improvement over the mechanical conveyor system it replaced, requiring less attention on their part and being less demanding of maintenance work.

The slurry system is not completely trouble-free. The use of saltcakes containing free acid results in a foamy slurry due to the release of hydrogen sulphide during slurrying, and the main circulating pump occasionally becomes gas bound and fails to pump a normal flow. Plugging of the main circulating line has occurred several times due to this cause, necessitating cutting the line for cleaning. The addition of kerosene as a defoamer prevents this trouble and its use has become routine when acid saltcakes are being used. The acid saltcake also precipitates lignin from the slurrying liquor, and it is necessary to control the temperature of the slurry to prevent the coagulation of the lignin at high temperatures and subsequent plugging of the pumps. This is accomplished by a simple water jacket on the weak liquor supply line.

The slurry system was placed in operation in October, 1956, and has been in continuous use since that time. It is felt that the benefits expected from the system at the time of its design have been realized. Control over saltcake addition is now excellent, the presence of saltcake dust in the recovery room has been eliminated, less operating attention is required, and maintenance has been greatly reduced.

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# Factors in Drying Papers Treated with Water Soluble Phenolic Resins

W. ALLAN SCHENCK

**Drying curves are reported for paper treated with water soluble phenolic resins having varying degrees of polymerization. For all cases the volatile dropped rather rapidly, then leveled off and decreased at a slower and constant rate. It is believed the bulk of the resin solvent had been removed when the rate of decrease in volatile leveled off. Further reduction in volatile was attributed to polymerization of the resin and evaporation of the water of condensation. The effect of degree of polymerization on point of solvent removal and on treating speed are discussed for both water and alcohol-water systems.**

Paper-base phenolic laminates have been produced and sold for many years. These products are utilized in decorative panels, electrical panels, tubes, gears, bearings, housings, and many other similar applications. They are customarily manufactured by treating absorbent rag, alpha, or kraft wood pulp papers with varnishes consisting of various modified phenol formaldehyde resins dissolved in alcohol. In most cases, these resins are not water soluble because of their degree of polymerization or because they are modified in their chemical composition.

Only in relatively recent years have lower cost water soluble phenolic resins been combined with paper to produce special properties of industrial interest. The water soluble resins are being used as a pretreatment before conventional phenolic varnish in laminating paper to obtain better fiber impregnation and resultant high-pressure laminates of a maximum degree of water and moisture resistance. These laminates are used in newer electrical applications.

Both Burns (*1*) and Thomas (*2*) have discussed the use of phenolic-cellulose battery separators. Thomas indicated this product is commonly made from water soluble phenolic resins for maximum acid and electrolytic resistance in lead-acid storage batteries. The volume has grown from nothing in 1950 to around 25,000,000 lb. in 1957.

A third product for which water soluble phenolic resins are being offered and considered is automotive oil filters. Dow (*3*) has published the requirements of resin-paper combinations for this end use. In this application the water soluble resins lower cost, greater stiffness, and greater stabilizing effect are of potential interest.

Water soluble resins are usually more difficult to dry than alcohol varnishes and this is a major factor in the economics of their use. The laboratory work reported in this paper was a study to obtain fundamental information on the drying of paper treated with water soluble resins.

## METHODS AND PROCEDURES

The apparatus and materials used in the resin drying experiments were:

1. Sheets of machine made waterleaf paper, 8 by 10 in. weighing 115 lb. per 3000-sq. ft. ream. This paper was prepared from unbleached sulphate pulp beaten to 700 ml. Canadian freeness.
2. Fifty-milliliter weighing bottles.
3. A hot and cold pan balance with a reproducibility of ±2 mg. The hot oven was controlled at 300 ±5°F.
4. Suitable 9 by 12-in. enamel tray for dipping test sheets.
5. Standard TAPPI pulp testing blotters.
6. Standard couch roll.

W. A. Schenck, Upper Mills Manager, Riegel Paper Corp., Riegelsville, N. J.

**Table I. Sample Calculations**

| | | |
|---|---|---|
| 1. | Weight paper + resin + weight bottle | 78.000 |
| 2. | Weight of weighing bottle | 60.000 |
| 3. | Weight of paper + resin (1-2) | 18.000 |
| 4. | Weight of B D paper | 6.000 |
| 5. | Weight of resin solution (3-4) | 12.000 |
| 6. | Weight of paper after drying | 12.000 |
| 7. | Weight of paper after curing | 10.800 |
| 8. | Weight of volatile (6-7) | 1.200 |
| 9. | Per cent volatile | 10.0 |
| 7. | Weight of paper after curing | 10.800 |
| 4. | Weight of B D paper | 6.000 |
| 10. | Weight of resin solids in paper (7-4) | 4.800 |
| 11. | Weight of resin solids put in paper-(5) × % solids in resin solution | 6.000 |
| 12. | Resin yield 10/11 × 100 | 80.0% |

7. Steam heated handsheet drier controlled to surface temperature of 250°F.

8. Clean wool press felt material.

9. Unless otherwise specified, resin solutions were adjusted to a solids content of 48 to 52%.

The procedure was to dry a sheet of the saturating paper to the moisture-free condition, determine its weight hot, and immediately float it on the resin solution. After 1 min. of saturation, the paper was drained and couched between new blotters, using five complete passes with the couch roll. The pressed sheet was immediately folded and weighed in a tared weighing bottle. The sheet was then put on the freshly sanded handsheet drier, covered with clean wool felt and dried the desired length of time, without turning. The treated and dried sheet was immediately weighed, then fully cured in a 300°F. oven for 10 min. and re-weighed for determination of volatile content. A sample calculation of results is shown in Table I.

Care was taken to make the weighings promptly. With this precaution reproducible results were readily obtained. Table II gives typical results on duplicate experiments. Laboratory data obtained by this procedure can be used to calculate the yield of water soluble phenolic resins with good reproducibility. Such data can be correlated with factory results and can be valuable in developing improved yield resins or screening new resins.

*Volatile Content.* Volatile content was determined as the per cent loss in weight of a resin treated paper on curing 10 min. at 300°F.

**Table II. Representative Drying Data**

Exp. 456-1
(dilutability 12.0/1)

| *Drying time, to air dry sec.* | *Volatile, %* A | B | *Av.* | *Difference* |
|---|---|---|---|---|
| 20 | 22.9 | 24.4 | 23.7 | 0.8 |
| 40 | 15.5 | 16.5 | 16.0 | 0.5 |
| 60 | 14.4 | 14.7 | 14.6 | 0.2 |
| 80 | 13.8 | 13.7 | 13.8 | 0.1 |
| 100 | 12.9 | 12.3 | 12.6 | 0.3 |
| 120 | 12.0 | 11.1 | 11.6 | 0.5 |
| 160 | 10.4 | 10.8 | 10.6 | 0.2 |
| 200 | 9.8 | 10.4 | 10.1 | 0.3 |
| 240 | 9.1 | 9.3 | 9.2 | 0.1 |
| 280 | 8.3 | 8.6 | 8.5 | 0.2 |
| 320 | 8.1 | 8.1 | 8.1 | 0.0 |
| 360 | 7.0 | 7.4 | 7.2 | 0.2 |

Average difference 0.3

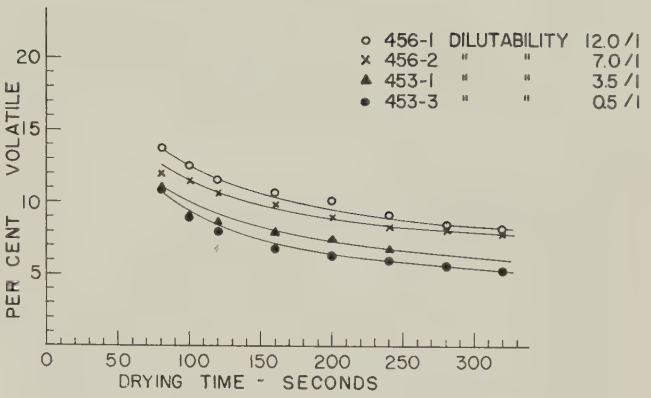


*Fig. 1. Effect of drying time on volatile*

*Water Dilutability.* Water dilutability of water soluble phenolic resin was determined as the volumes of water at 77°F. with which 1 volume of 70% solids resin could be diluted before a fraction of resin solids precipitated out of solution.

*Viscosity.* Viscosity of resin solutions was determined at 77°F. using a Brookfield viscosimeter.

*Polymerization of Resin Solutions.* The degree of polymerization of resin solutions was increased by heating 1020 g. of 70% solids resin solution at 180 to 200°F. in a water bath with agitation for the desired length of time. The solution was then quickly cooled and any water lost by evaporation replaced. Two 10-g. samples were weighed out for solids determination and the remaining 1000 g. of resin were diluted with water, ethyl alcohol, or a mixture of the two to give a resin solution containing 50% solids.

*Materials.* The resin used in this work was a commercial water soluble resin with the following characteristics: mol ratio—approximately 1-mol phenol to 2 mols formaldehyde, catalyst—sodium hydroxide, solids—nominal 70%.

## EXPERIMENTAL WORK AND DISCUSSION

### *Effect of Dilutability on Drying Time*

It has been generally recognized in a qualitative way that thermoset resins will dry faster, the greater the degree of polymerization. Figure 1 shows quantitatively the change in volatile with drying time for the same commercial water soluble phenol formaldehyde resin at varying degrees of polymerization as indicated

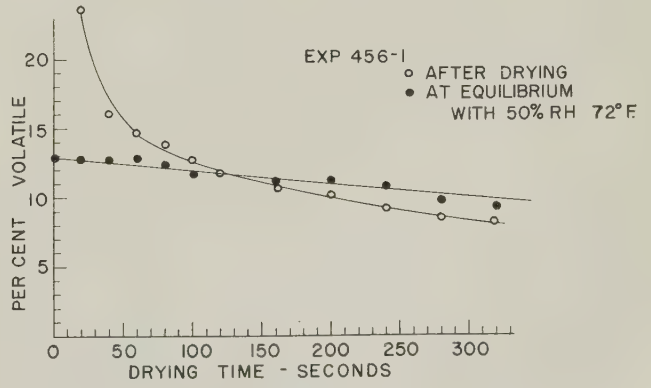


*Fig. 2. Effect of drying time on volatile*

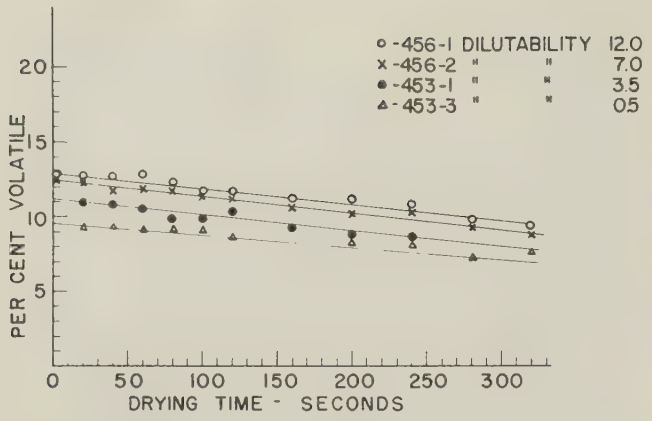


*Fig. 3. Effect of drying time on equilibrium volatile—50% R.H.—72°F.*

by water dilutability. From a graph such as this, it is possible to read off the drying time required for a given volatile and also get a relative measure of the change in drying time which would result from a change in volatile specification.

Paper treated with water soluble phenolic resin and dried to a given volatile will not stay at that volatile if exposed to varying humidity conditions. Figure 2 shows how volatile of 12 to 1 dilutability resin changes on humidification at 50% R.H. and 72°F. This effect is much greater at higher humidities. It is apparent the resin at this stage acts as a humectant in the paper. This resin (under the conditions of this experiment) has an equilibrium volatile content without further reaction of 13.0%. The bulk of the solvent is removed after 130 sec. at which point the equilibrium volatile is 11.5%. Another 170 sec. which is double the drying time, is required to lower the equilibrium volatile another 1.5% to 10.0%. This is still too high for most uses.

Figure 3 shows the equilibrium volatile content of the original resin at four dilutabilities. The volatiles at equilibrium with no drying were 13.0, 12.5, 11.2, and 9.5%, respectively. This is a good property for characterizing such resins. At 0.5/1 dilutability the equilibrium volatile content with no additional drying is comparable to 12 to 1 dilutability after 300 sec. drying.

Table III summarizes the data of Figs. 1, 2, and 3. The viscosity increase and the dilutability decrease was a measure of the change in degree of polymerization. The drying time to 8% volatile decreased from 325 sec. to 130 sec. for the range of polymerization studied.

### *The Effect of Alcohol on Drying Time*

The effect of ethyl alcohol as a portion of the resin

**Table III. Effect of Dilutability on Drying Time**

| | Exp. No. 456-1 | 456-2 | 453-1 | 453-3 |
|---|---|---|---|---|
| Dilutability | 12-1 | 7-1 | 3.5-1 | 0.5-1 |
| Treating solution, % solids | 49.7 | 48.7 | 48.2 | 49.8 |
| Viscosity, poise | 0.12 | 0.14 | 0.26 | 0.33 |
| Drying time to 10% volatile (seconds) | | | | |
| Off drier | 180 | 145 | 100 | 90 |
| At equilibrium | 275 | 222 | 110 | Air dry |
| Drying time to 8% volatile | | | | |
| Off drier | Over 300 | 300 | 165 | 130 |
| At Equilibrium | Over 300 | 390 | 300 | 190 |

**Table IV. Effect of Alcohol on Drying Time High Dilutability**

Exp. No. 278-L

| | | | | | |
|---|---|---|---|---|---|
| Dilutability | 7.5/1 | | | | |
| Solids, % | 70.3 | | | | |
| Cure time, min. | | | | | |
| Water removed | 0.67 | | | | |
| Start thermoplastic | 7.0 | | | | |
| End thermoplastic | 11.25 | | | | |
| Completely cured | 26 | | | | |
| Dilution | | | | | |
| G. alcohol/G. solids | 0 | 0.14 | 0.28 | 0.42 | 0.57 |
| G. water/G. solids | 0.57 | 0.42 | 0.28 | 0.14 | 0.0 |
| Viscosity, poises | 0.18 | 0.20 | 0.22 | 0.22 | 0.22 |
| Yield, % | 89.1 | 89.8 | 89.4 | 92.7 | 91.6 |
| Drying time, sec. | | | | | |
| To 10% volatile | 145 | 145 | 145 | 145 | 145 |
| % Solids in paper | 54.4 | 53.5 | 54.0 | 53.7 | 51.2 |

solvent is shown in Fig. 4 and Table IV. The horizontal axis is expanded on this and succeeding graphs. This resin had a dilutability of 7.5 to 1. Taking the time to 10% volatile from the graph, we find it is about 145 sec. regardless of the diluent mixture used. As in the earlier work, the volatile dropped rapidly, then leveled off and decreased at a slower and constant rate, for all of the solvent compositions. It is believed the bulk of the resin solvent had been removed when the rate of decrease in volatile leveled off. Further reduction in volatile was attributed to polymerization of the resin and evaporation of the water of condensation. This reaction system was known to be complex and for this reason no effort was made to determine the order of the reactions.

Alcohol had little advantage in decreasing drying time for volatile levels which required some reaction during drying. Alcohol markedly reduced drying time in the case of volatile levels which did not require further polymerization. This was shown clearly in Table V and Fig. 5 which presents the effect of alcohol diluent at 1 to 1 dilutability.

### *Polymerization of Resin and Alcohol Dilution*

The next area studied was water soluble resin advanced into the range where it would no longer tolerate dilution with water. Fifty per cent solids concentration treating solutions were prepared by dilution with ethyl alcohol and drying curves determined. These are shown in Fig. 6. The upper curve is resin with a dilutability of 1.5 to 1 diluted to 50% solids with water. The second curve is the same resin

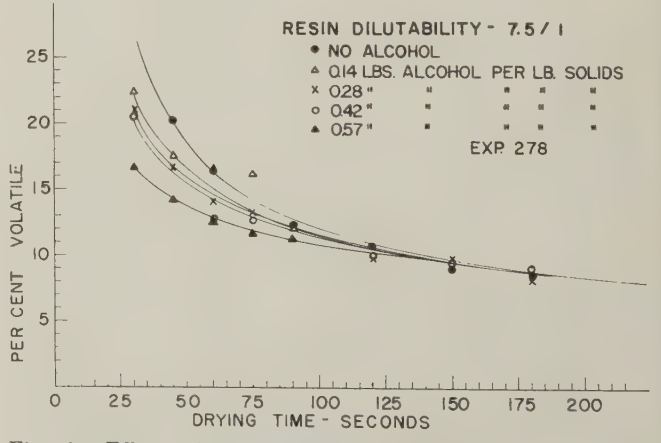
RESIN DILUTABILITY - 7.5 / 1
• NO ALCOHOL
▲ 0.14 LBS. ALCOHOL PER LB. SOLIDS
x 0.28 " " " " "
o 0.42 " " " " "
▲ 0.57 " " " " "
EXP. 278
PER CENT VOLATILE
DRYING TIME - SECONDS

*Fig. 4. Effect of various amounts of alcohol on drying time, 245–250°F.*

**Table V. Effect of Alcohol on Drying Time, Low Dilutability**

Exp. No. 279-L

| | | |
|---|---|---|
| Dilutability | 1/1 | |
| Solids, % | 68.2 | |
| Cure time, min. | | |
| Water removed | 0.33 | |
| Start thermoplastic | 3.5 | |
| End thermoplastic | 7.25 | |
| Completely cured | 18.5 | |
| Dilution | | |
| G. alcohol/G. solids | 0.0 | 0.57 |
| G. water/G. solids | 0.57 | 0.0 |
| Viscosity, poises | 0.36 | 0.30 |
| Yield, % | 92.0 | 94.7 |
| Drying time, sec. | | |
| To 8% volatile | 155 | 120 |
| To 10% volatile | 97 | 48 |
| % Solids in paper | 56.9 | 53.2 |

diluted with alcohol. Succeeding curves are after polymerization at 190°F.

Table VI summarizes the data. The drying time to 8% volatile was 55 sec. compared to 325 sec. for the same resin at 12 to 1 dilutability and diluted with water.

**Table VI. Effect of Polymerization, Resin A**

| | Exp. No. 269. | 270. | 272 | | | |
|---|---|---|---|---|---|---|
| Heating time, hr. | 0[a] | 0 | 1 | 2 | 3 | 4 |
| Dilutability | 1.5/1 | 1.5/1 | ... | ... | ... | Gelled |
| Resin solids | 69.7 | 69.7 | 70.5 | 69.4 | ... | ... |
| Cure time, min. | | | | | | |
| Water off | 1.25 | 1.25 | 1.0 | 0.8 | ... | ... |
| Start thermo | 5.0 | 5.0 | 3.0 | 0.5 | ... | ... |
| End thermo | 10.5 | 10.5 | 8.7 | 8.3 | ... | ... |
| Cured | 27 | 27 | 25 | 16 | ... | ... |
| G. alcohol/G. solids | 0.57 | 0.57 | 0.57 | 0.57 | 0.57 | ... |
| % Solids solution | 49.1 | 50.7 | ... | 47.2 | 49.9 | ... |
| Viscosity, poises | ... | 0.40 | ... | ... | 1.28 | ... |
| Yield, % | 94.1 | 94.8 | ... | 96.8 | 98.6 | ... |
| Drying time, sec. | | | | | | |
| To 8% vol. | 180 | 135 | 80 | 63 | 56 | ... |
| To 10% vol. | 115 | 65 | 54 | 50 | 37 | ... |
| Solids in paper | 56.4 | 54.1 | 55.4 | 55.7 | 55.8 | ... |
| Sheet stick drier | None | None | None | None | Slight | ... |

[a] Diluted with water. No alcohol used.

It is interesting to note the effect of this polymerization on cure time, viscosity, and yield. The cure time decreased, the viscosity increased, and the yield increased.

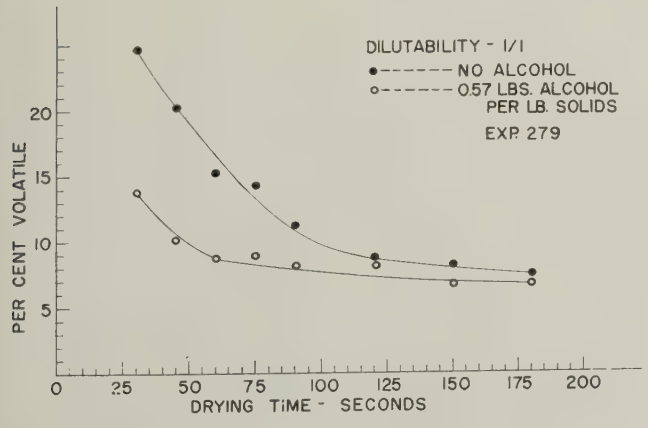


*Fig. 5. Effect of alcohol on drying time, 245–250°F.*

Table VII presents similar data for a second but slower curing phenol formaldehyde resin. The drying time is 260 sec. to 8% volatile compared to 180 sec. both at 1 to 1 dilutability. The effect of polymerization on cure time, viscosity, and yield are similar to that found on the previous resin.

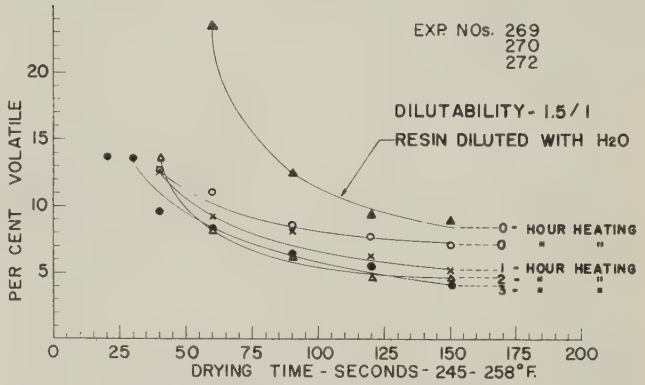


*Fig. 6. Effect of heating resin on drying time period. Dilute with ethyl alcohol-0.57 lb. alcohol per lb. resin solids*

## SUMMARY OF RESULTS

Summarizing this work, the following conclusions were drawn:

1. Drying curves revealed the volatile dropped rapidly, then leveled off and decreased at a slower and constant rate. The bulk of the resin solvent was considered removed when the rate of decrease in volatile leveled off. Further reduction in volatile was attributed to polymerization and evaporation of the water of condensation. The more advanced the degree of polymerization of the resin, the lower the volatile content at the point of solvent removal.

2. The more advanced the resin solution, the shorter the drying time, or from an operating standpoint, the faster a treater can be operated. Speed increases of over five hundred per cent were indicated by these results. This is a large potential cost reduction. The extent to which the degree of polymerization can be increased to speed up drying for a given process or product will be limited by other factors, such as: (1) viscosity of treating solution, (2) economic practi-

**Table VII. Effect of Polymerization, Resin B**

| | 280-L | Exp. No. 277 | | | | | |
|---|---|---|---|---|---|---|---|
| Heating time, hr. | 0[a] | 0 | 1 | 2 | 4 | 5 | 6 |
| Dilutability | 1/1 | 1/1 | | | | | |
| Resin solids | 64.0 | 64.0 | 62.8 | 64.8 | 65.8 | 68.0 | 68.5 |
| Cure time, min. | | | | | | | |
| Water off | 0.35 | 0.35 | 0.16 | 0.16 | 0.13 | 0.25 | 0.3 |
| Start thermo | 8.5 | 8.5 | 6.3 | 5.5 | 3.25 | 2 | 1.75 |
| End thermo | 15 | 15 | 12.5 | 12 | 10.5 | 8.75 | 7 |
| Cured | 32 | 32 | 28 | 26 | 25 | 24.75 | 24 |
| G. alcohol/G. solids | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 | 0.40 |
| Viscosity, poises | 0.18 | 0.28 | 0.29 | 0.32 | 0.58 | 0.80 | 1.30 |
| Yield, % | 86.8 | 86.5 | 87.9 | 89.9 | 95.1 | 99.1 | 98.5 |
| Drying time, (sec.) | | | | | | | |
| To 8% vol. | 260 | 260 | 260 | ... | 142 | ... | 78 |
| To 10% vol. | 200 | 200 | 180 | ... | 73 | ... | 54 |
| Solids in paper | ... | 51.3 | 51.4 | 53.2 | 54.3 | 56.0 | 56.2 |
| Sheet stick drier | None | None | None | None | None | None | None |

[a] Diluted with water. No alcohol used.

cality of using alcohol, and (3) required stabilization of cellulose fiber to moisture at higher degrees of resin polymerization.

We conclude from this work that when treating paper with water soluble phenolic resins the resin should be polymerized just as far as process and product quality considerations will permit.


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# Free-Surface Instability*


CHIA-SHUN YIH and ARIS C. SPENGOS



**Free-surface instability of a fluid associated with the operation of a fourdrinier machine is investigated. Taylor's theory is applied to the instability of the fluid as it passes over the table rolls, and experiments have been performed on the growth of disturbances over and downstream from these rolls. A new analysis has been carried out for the formation of rings from a thin layer of fluid attached to and rotating with the table rolls, and numerical results are given for large Reynolds numbers.**


In the operation of the fourdrinier machine it has often been observed that the stock spouts after each table roll, especially when the speed of the pulp-carrying wire is high. Since the fourdrinier machine plays a very important role in the manufacture of paper, it is obvious that the quality of the paper produced (or at least the efficiency of papermaking) depends, among other things, on the control of the intensity of spouting. Since the beginning of last year, the Engineering Mechanics Department of the University of Michigan has been engaged in an analytical and experimental study of problems involving instability of a fluid with a free surface, with the purpose of determining the effects of various pertinent parameters on the degree of free-surface instability, from which spouting may result.

After a year's study, many definite results have been obtained. Since many previous investigators have claimed that the cause of free-surface instability observed on the wire of the fourdrinier machine is the large downward acceleration that the fluid experiences as it passes over the table rolls, it was decided to perform an analysis of the rate of growth of disturbances as they pass over the table rolls. In the analysis to be presented in the following section, the effects of surface tension, the wavelengths (in two orthogonal directions) of the three-dimensional disturbances, the downward acceleration, and the gravitational force have been considered, but those of Coriolis accelerations and of viscosity have been neglected. The effects of Coriolis accelerations and viscosity were later considered in an analysis by the first author for axisymmetric disturbances in a totating liquid film, to be presented in section 4 of this paper. When the more refined analysis was compared with the simplified one for a case to which both analyses are applicable, it was found that for large Reynolds numbers and for large growth rates of the disturbances the results according to the two analyses are essentially the same. Measurements of the growth rate over table rolls have verified the trend predicted by simple analysis, though a refinement of the apparatus is very much to be desired in order to have a better control of the wave lengths.

As to the growth of the disturbance after the table rolls, no adequate analysis has yet been achieved. Experiments show that downward acceleration can no longer be considered as the cause for the sudden growth of the disturbance. The idea of "residual growth," devised to salvage the explanation by downward acceleration, has not turned out to be capable of forming the basis for a theory. Consequently, resort was made entirely to experimentation guided by a dimensional analysis. The results show that the apparatus used (see Fig. 1) can definitely reproduce spouting, even though the bottom of the channel is a rigid, stationary

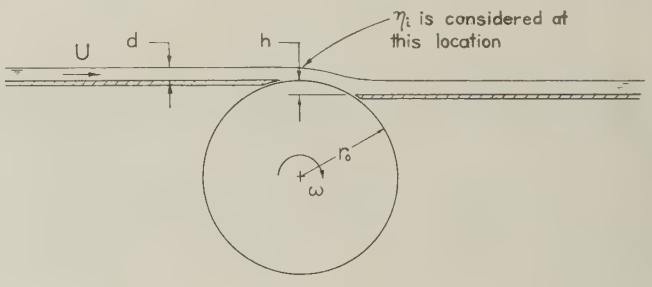


*Fig. 1. Sketch of apparatus*

plane instead of a moving wire screen. This fact can hardly be overemphasized, because it shows that the "step-down" simulating the wrapping of the wire is chiefly responsible for spouting (see Plates I, II), the vibration of the wire having only a secondary effect. As will be shown in section 2, the step height $h$ has a pronounced effect on the growth of the disturbances: the larger $h$ is, the greater the maximum amplitude of the disturbance after the table roll.

On the surface of the table rolls beneath the wire screen, previous investigators have observed rings of fluid rather evenly spaced in the longitudinal direction. These rings, which are essentially caused by the centripetal acceleration of the fluid, have also been observed on the cylinder used in the experiments to


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simulate the table rolls. In order to understand this phenomenon fully, and to provide an analysis to supplement the simple one made for the flow directly over the cylinder, an analysis for these rings has been performed by the first author. The effects of surface tension, of viscosity, and of Coriolis' acceleration have been fully taken into account, though the earth's gravitation has been neglected. Thus an analysis of a phenomenon of hydrodynamic instability caused by both rotation and the presence of a free surface is now available, whereas previously Taylor's analyses for fluid flow between rotating cylinders and for a fluid undergoing downward acceleration were relied upon for a good, but nevertheless piecemeal, understanding of the phenomenon. An outline of the analysis and a comparison of it with the simple analysis in section 1 will be presented in section 3.

## 1. FLOW OVER THE TABLE ROLLS

The downward acceleration that the fluid of thickness $d$ experiences as it passes over the cylinder in the laboratory (simulating the table rolls in the actual machine) is

$$a = \omega^2 r_0 \tag{1}$$

in which $r_0$ is the radius of the cylinder, and $\omega$ is its angular speed which is connected with the mean velocity $U$ of flow in the channel by

$$U = \omega r_0 \tag{2}$$

If the effect of curvature of the cylinder is neglected, the problem can be treated as one in which a layer of fluid with thickness $d$ is turned upside down, (Fig. 2),

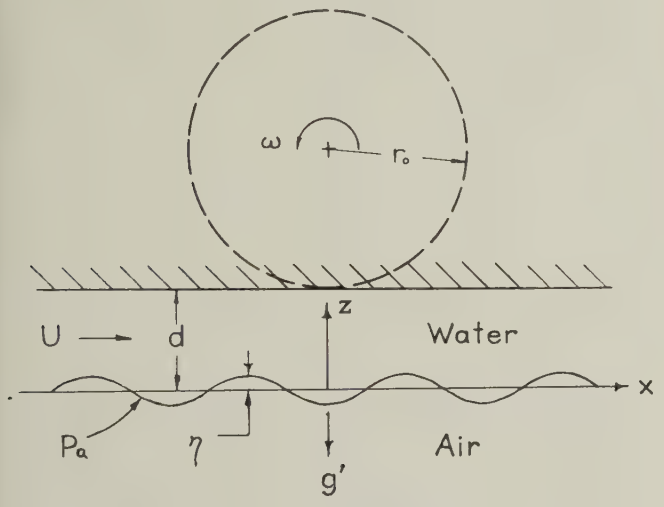



*Fig. 2. Definition sketch*

with the solid boundary on tip, and is acted upon by a virtual gravitational force per unit mass of

$$g' = a - g \tag{3}$$

in which $g$ is the actual gravitational force per unit mass exerted by the earth.

If the viscosity of the fluid is neglected and the motion is assumed to be irrotational, the velocity potential $\phi$ for the disturbance satisfies the Laplace equation

$$\phi_{xx} + \phi_{yy} + \phi_{zz} = 0 \tag{4}$$

in which subscripts indicate partial differentiation. The boundary condition at the solid boundary is, with $u$, $v$, and $w$ denoting the velocity components in the directions of increasing $x$, $y$, and $z$,

$$w = -\phi_z = 0 \qquad \text{at} \qquad z = d \tag{5}$$

The kinematic condition at the free surface is, for a frame moving with velocity $U$,

$$\zeta_t = W = -\phi_z \qquad \text{at} \qquad z = 0 \tag{6}$$

in which $\zeta$ is the deviation (in the $z$ direction) from the mean free surface, and $t$ is the time. Since the pressure at the free surface is

$$p = p_a + \left(\frac{1}{R_1} + \frac{1}{R_2}\right) = p_a + T(\zeta_{xx} + \zeta_{yy}) \tag{7}$$

in which $p_a$ is the atmospheric pressure, $T$ is the surface tension, and $R_1$ and $R_2$ are the principal radii of curvature, which for small disturbances of the free surface are equal to $\zeta_{xx}$ and $\zeta_{yy}$, respectively. On the other hand, the Bernoulli equation yields, with second-order terms in the perturbation velocity neglected and with $\rho$ denoting the density,

$$\frac{p}{\rho} = \phi_t - gz + C$$

so that the dynamic boundary condition to be satisfied at the free surface is

$$\phi_t - g'\zeta = \frac{T}{\rho}(\zeta_{xx} + \zeta_{yy}) \tag{8}$$

if the constant $C$ is taken to be $p_a/\rho$.

The differential system consisting of equations (4), (5), (6) and (8) is satisfied by ($c$ = a constant)

$$\phi = c \sinh qt \cosh k(z - d) \cos mx \cos ny \tag{9}$$

provided

$$k^2 = m^2 + n^2 \tag{10}$$

and

$$q^2 = \left(kg' - \frac{T}{\rho}k^3\right) \tanh kd \tag{11}$$

with the corresponding free-surface deviation given by

$$\zeta = \eta \cos mx \cos ny, \quad \eta = \eta_i \cosh qt, \quad \eta_i = -\frac{ck}{q} \sinh kd \tag{12}$$

In these formulas $m = 2\pi/\lambda_1$, $n = 2\pi/\lambda_2$, and $\lambda_1$ and $\lambda_2$ are the wavelengths in the directions of $x$ and of $y$, respectively. The result obtained needs careful interpretation. In the analysis it has been assumed that the fluid flows with a mean velocity $U$ and uniformly undergoes an acceleration $g'$, starting from $t = 0$ with a surface corrugation but no perturbation velocity. In the acutal flow in the experiments the acceleration does not start until the fluid comes on top of the cylinder. Here the time average for the initial amplitude $\eta_i$ has been measured. Subsequent time-average measurements for $\eta$ have been made at various values of $x$, the corresponding $t$ being taken to be $x/U$. Thus, with $\eta_i$ taken at $x = 0$ (the top of the table rolls), one has

$$\frac{\eta_i}{\eta} = \cosh \frac{qx}{U} \tag{13}$$

The experimental data obtained are plotted in Fig. 3, with the wavelengths taken directly from the experiment. Whereas a more accurate determination of

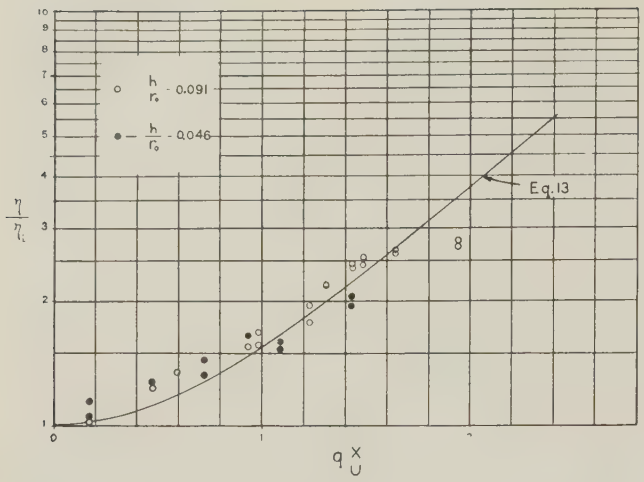



*Fig. 3. Growth of disturbances over the table roll*

the wavelengths is very much to be desired, it can be calimed that the data verify the trend of equations (11) and (13) and that the cause for instability of the fluid while flowing over the cylinder (or the table rolls) is indeed the downward acceleration experienced by the fluid. The $k$ for the most unstable disturbance can be obtained by differentiating equation (11) with respect to $k$ and equating the results to zero:

$$0 = 2q\frac{dq}{dk} = \left(g' - \frac{3T}{\rho}k^2\right) \times \tanh kd + d\left(g'k - \frac{T}{\rho}k^3\right)\operatorname{sech}^2 kd \quad (14)$$

However, the selection process does not have time enough to make the most unstable mode of the disturbance prominent, and the wavelengths over the cylinder are still largely determined by upstream conditions. The above analysis is chiefly that of Taylor.

## 2. FLOW SUBSEQUENT TO THE TABLE ROLLS

Since the flow subsequent to the table rolls is not amenable to analysis at present, a dimensional analysis has been performed to guide the experimentation. With the maximum amplitude $\eta$ of the disturbance in the flow subsequent to the table rolls as the dependent variable, one has

$$\eta = f(\eta_i, d, h, r_0, U, \rho, T, \mu, g) \quad (15)$$

in which $h$ is the step height (Fig. 1), $\mu$ is the dynamic viscosity, and $\eta_i$ is the initial amplitude measured at the top of the cylinder. In a linear theory this general functional relationship can be simplified to

$$\frac{\eta}{\eta_i} = f_1(d, h, r_0, U, \rho, T, \mu, g) \quad (16)$$

A dimensional analysis then yields

$$\frac{\eta}{\eta_i} = F\left(\frac{d}{h'}\frac{r_0}{d'}\frac{T}{\rho U^2 d'}\frac{Ud\rho}{\mu}, \frac{U}{\sqrt{gd}}\right) \quad (17)$$

or

$$\frac{\eta}{\eta_i} = F_i\left(\frac{h}{d'}\frac{r_0}{d'}\frac{Td\rho}{\mu^2}, R, F\right) \quad (18)$$

in which

$$R \text{ (Reynolds number)} = \frac{Ud\rho}{\mu}$$
$$F \text{ (Froude number)} = \frac{U}{\sqrt{gd}} \quad (19)$$

In the experiments performed so far, $T$, $d$, $r_0$, $\rho$ and $\mu$ have been kept constant, so that for these experiments,

$$\frac{\eta}{\eta_i} = F_2\left(\frac{h}{r_0}, R, F\right) \quad (20)$$

If it is assumed that the effect of viscosity can be neglected, $R$ can be dropped from equation (20), so that, finally, the equation to be used for organization of experimental data is

$$\frac{\eta}{\eta_i} = F_3\left(\frac{h}{r_0}, F\right) \quad (21)$$

The experimental data are shown in Fig. 3, from which it can be seen that they are indeed consistent with equation (21) and seem rather reasonable, with $\frac{\eta_{max.}}{\eta_i}$ increasing both with $h/r_0$ and with $F$. More experiments will be performed by varying $h/r_0$ and F in the current year. As stated before, the most important conclusion to be drawn from the measurements made after the cylinder is that the amount of wrapping (simulated by a "step-down") is chiefly responsible for the phenomenon of spouting, vibration of the wire screen being of only secondary importance. This conclusion is strengthened by the experiments conducted before under the supervision of Charles A. Lee on a fourdrinier machine, which indicated strongly that spouting decreases as the amount of wrapping decreases.

## 3. INSTABILITY OF A ROTATING LIQUID FILM WITH A FREE SURFACE

The mean flow of the liquid film attached to the rotating cylinder can be assumed to be purely rotational, but this purely rotational motion is not stable, due to the presence of a free surface. If $t$ is measured in terms of $1/\omega$, the cylindrical coordinates $r$ and $z$ are measured in terms of $r_0$, all velocities in terms of $\omega r_0$, and the pressure in terms of $\rho\omega^2 r_0^2$, the dimensionless mean velocity is simply

$$\bar{V} = r \quad (22)$$

and the mean pressure gradient in simply

$$\frac{\partial \bar{p}}{\partial r} = r \quad (23)$$

If the components of dimensionless perturbation velocity in the directions of the cylindrical coordinates

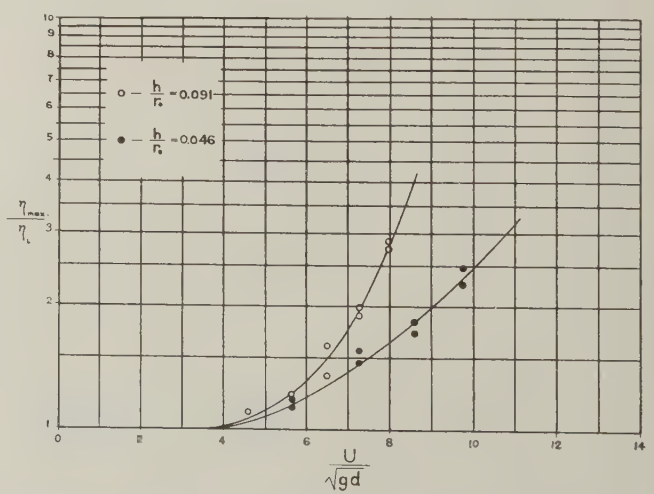



*Fig. 4. Growth of disturbances downstream from the table roll*

$(r, \theta, z)$ are denoted by $(u, v, w)$, and the perturbation pressure is denoted by $p$, the linearized equations of motion (with second and higher orders of the perturbation quantities neglected) are, for axisymmetric flows,

$$\frac{\partial u}{\partial t} - 2v = -\frac{\partial p}{\partial r} + \frac{1}{R_0}\left(\nabla^2 u - \frac{u}{r^2}\right) \qquad (24)$$

$$\frac{\partial v}{\partial t} + 2u = \frac{1}{R_0}\left(\nabla^2 v - \frac{v}{r}\right) \qquad (25)$$

$$\frac{\partial w}{\partial t} = -\frac{\partial p}{\partial z} + \frac{1}{R_0}\nabla^2 w \qquad (26)$$

in which

$$\nabla^2 = \frac{\partial^2}{\partial r^2} + \frac{1}{r}\frac{\partial}{\partial r} + \frac{\partial^2}{\partial z^2} \qquad (27)$$

and $R_0 = \omega r_0^2 \rho/\mu$ is the Reynolds number based on $r_0$. Equations (24) to (26) are to be solved in conjunction with the equation of continuity

$$\frac{\partial u}{\partial r} + \frac{u}{r} + \frac{\partial w}{\partial z} = 0 \qquad (28)$$

The boundary conditions at the cylinder surface are

$$u = v = w = 0 \quad \text{at} \quad r = 1 \qquad (29)$$

The kinematic condition at the free surface is, with $\eta^*$ denoting the (dimensionless) deviation of the free surface from its mean position,

$$\eta_t^* = u \quad \text{at} \quad r = 1 + \frac{d}{r_0} \qquad (30)$$

in which $d$ is the thickness of the liquid film. The dynamic conditions at the free surface are

$$\text{shear stresses } \tau_{r\theta} \text{ and } \tau_{rz} = 0 \quad \text{at} \quad r = 1 + \frac{d}{r_0} = \alpha \qquad (31)$$

and

$$\text{normal stress } \sigma_{rr} = 0 \quad \text{at the free surface.} \qquad (32)$$

Conditions (31) can be replaced by

$$r\frac{\partial}{\partial r}\left(\frac{v}{r}\right) = 0 \quad \text{and} \quad \frac{\partial u}{\partial z} + \frac{\partial w}{\partial r} = 0 \quad \text{at} \quad r = \alpha \qquad (33)$$

Condition (32) has to be imposed on the free surface where $r = a + \eta^*$, because the mean pressure gradient will affect $\sigma_{rr}$ over the distance $\eta^*$. With the surface tension $T$ taken into account, condition (32) becomes

$$-p - \frac{\partial \bar{p}}{\partial r}\eta^* - \frac{T}{\rho\omega^2 r_0^3}\frac{\partial^2 \eta^*}{\partial z^2} + \frac{2}{R_0}\frac{\partial u}{\partial r} = 0 \qquad (34)$$

The differential system consisting of equations (24) to (30), (33), and (34) are linear and homogeneous, and of course admit of the trivial solution

$$u = v = w = p = \eta^* = 0$$

If a non-trivial solution is wanted, a relationship between the parameters of the problem, such as $R_0$, $T/\rho\omega^2 r_0^3$, the wave length $\lambda$ of the disturbance, the rate of growth of the distrubance, and $d/r_0$, must be satisfied. A problem which can be formulated by a system of homogeneous linear equations is called an eigenvalue problem, because if all pertinent parameters but one are

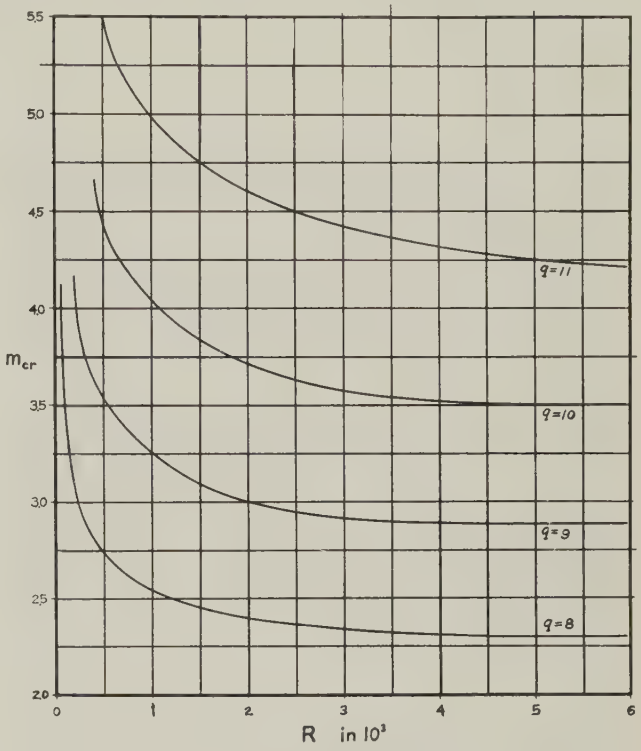



***Fig. 6. Relationship between $m_{cr}$, $q$, and $R$ for $1 + r_0/d = 50$***

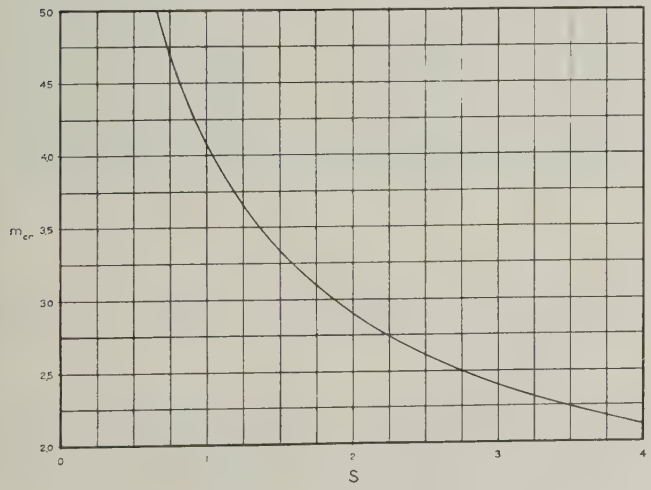



***Fig. 5. Dependence of $m_{cr}$ on S, for $1 + r_0/d = 50$***

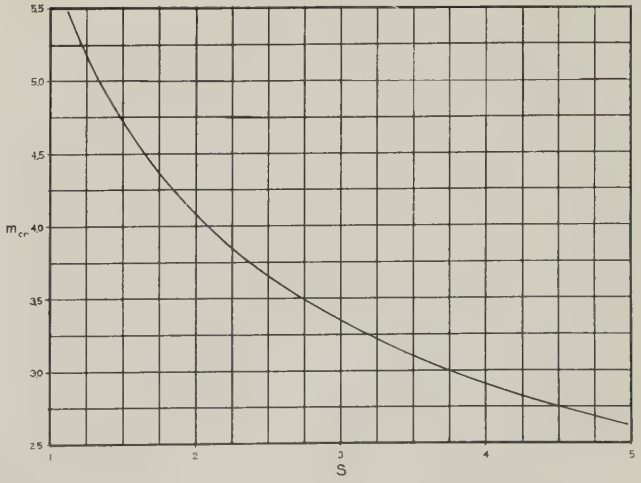



***Fig. 7. Dependence of $m_{cr}$ on S, for $1 + r_0/d = 100$***

fixed, the remaining parameter must assume a particular value in order for the differential system to possess a non-trivial solution. The problem under discussion is therefore an eigenvalue problem.

The actual solution of the differential system is very lengthy and elaborate. Even for the (realistic) cases of small $d/r_0$, the calculation took more than thirty pages of calculation in the *final* form. Due to the lengthiness of the details of the calculation, only the

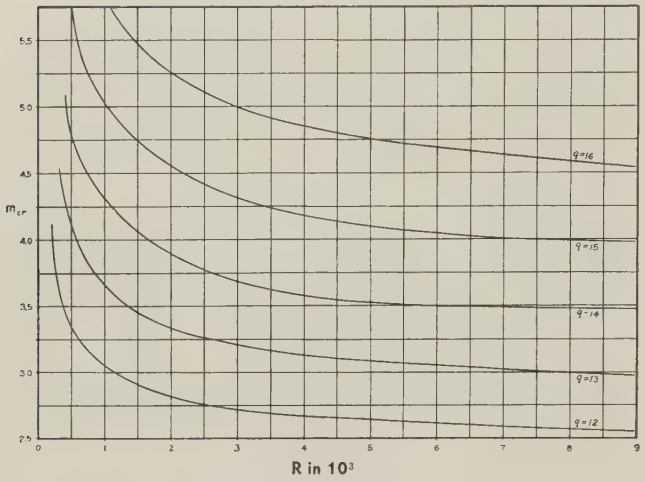



***Fig. 8. Relationship between $m_{cr}$, $q$, and $R$ for $1 + r_0/d = 100$***

final results will be recorded here. If $q$ is the dimensionless growth rate (in terms of $\omega$), then

$$\left(\frac{r_0 + d}{d} - \frac{T}{\rho\omega^2 d^3} m^2\right) m = 2q \sqrt{1 + \frac{q^2}{4}} \times \left\{ L + \frac{\alpha E'}{\sqrt{R}} + \frac{\alpha^2 \left[ L\left(H + \frac{7C - 1}{2}\right) + F \right]}{R} + \frac{\alpha^3 \left[ E(H - 1) + G + E'\left(\frac{7C + 1}{2}\right) + I + \sqrt{1 + C}\, L^2 \right]}{R\sqrt{R}} \right\} \tag{35}$$

in which

$R = \omega d^2 \rho/\mu$ = the new Reynolds number,

$$m = 2\pi d/\lambda, \alpha = \frac{2m}{q\sqrt{q}}, C = \frac{q^2}{4}, E' = E - \frac{2C + 1}{\sqrt{1 + C}}\left(1 - \frac{1}{\alpha}\right),$$

$$E = \sqrt{1 + C}\,(1 + L^2), L = \coth\left(\frac{2m}{q}\sqrt{1 + C}\right),$$

$$H = \frac{5C^2 + 2C - 1}{2(C + 1)} - \frac{1 + 2C}{\alpha},$$

$$F = M + (1 + C)L(L^2 - 1), M = -\frac{m}{\sqrt{C + C^2}} \operatorname{csch}^2\left(\frac{2m}{q}\sqrt{1 + C}\right),$$

$$G = \frac{1}{\sqrt{1 + C}}\left\{-1 + (1 + C)\left[\left(\frac{5}{8} - \frac{C}{2}\right) \times (L^2 - 1) + L(M + L_1)\right] + (1 + C)^2 L^2 (L^2 - 1)\right\},$$

$$L_1 = \frac{L}{1 + C} + M,$$

$$I = \frac{1}{2\sqrt{1 + C}}\left(4C^2 - \frac{7}{2}C + \frac{5}{4} + \frac{16C^2 + 62C + 11}{8\alpha}\right).$$

For zero viscosity, $R = \infty$, and with $r_0/d$ replacing $(r_0 + d)/d$ for simplicity, equation (35) reduces to

$$\left(\frac{r_0}{d} - \frac{T}{\rho\omega^2 d^3} m^2\right) m = 2q \sqrt{1 + \frac{q^2}{4}}\, L \tag{36}$$

which is what one would obtain if one started out with the equations of motion without the terms representing

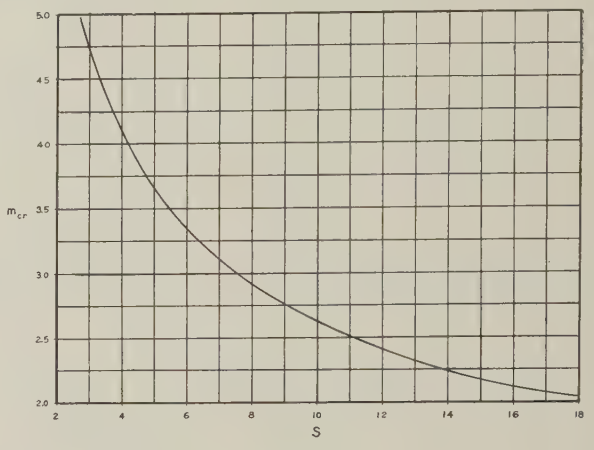



***Fig. 9. Dependence of $m_{cr}$ on S, for $1 + r_0/d = 200$***

viscosity and without the corresponding boundary conditions. Thus the complicated solution has withstood an independent check. For large $q$, equation (36) can be reduced to the dimensional form by multiplying both sides by $\omega^2$, to yield the equation for dimensional $q$ and dimensional $m$, for comparison with equation (11):

$$q^2 = \left(r_0\omega^2 m - \frac{T}{\rho} m^3\right) \tanh md \tag{37}$$

which is exactly the same as equation (11), with $k$ changed to $m$ (for two-dimensional disturbances) and

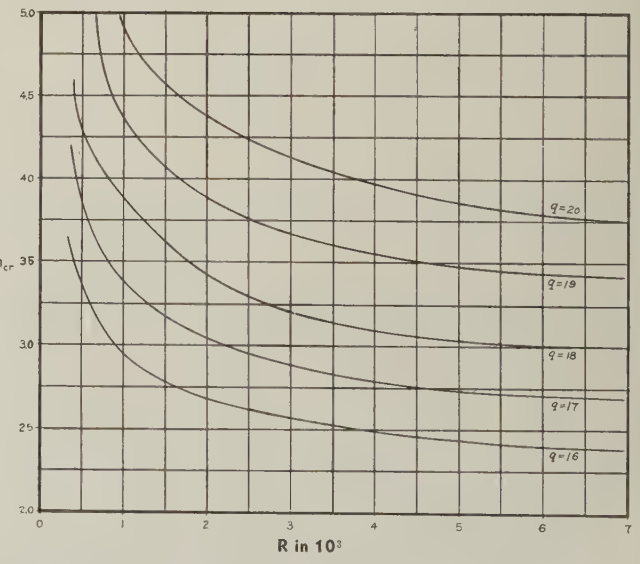



***Fig. 10. Relationship between $m_{cr}$, $q$, and $R$ for $1 + r_0/d = 200$***

with $g'$ replaced by $r_0\omega^2$, which is the sole acceleration if $g$ is neglected (as it is in the present analysis). Thus another independent check has been applied, and one can feel more confident both about the present analysis and about the simplified analysis of section 1.

To find the most unstable mode, or the $m$ for which the ring disturbances are most unstable, one differentiates (35) with respect to $m$, considering all parameters to be constant except $q$, and set $dq/dm$ to zero. The results are, with terms involving $R^{-1}$ and higher orders of $R^{-1}$ neglected,

$$\frac{r_0 + d}{d} - \frac{3T}{\rho\omega^2 d^3} m^2 = 2q\sqrt{1+C} \times \left\{ -\frac{2}{q}\sqrt{1+C}\,(L^2-1) + \sqrt{\frac{1+C}{R}}\left[\left(L^2 - \frac{C}{C+1}\right)\frac{2}{q\sqrt{q}} - \frac{4\alpha L(L^2-1)}{q}\sqrt{1+C}\right]\right\}. \quad (38)$$

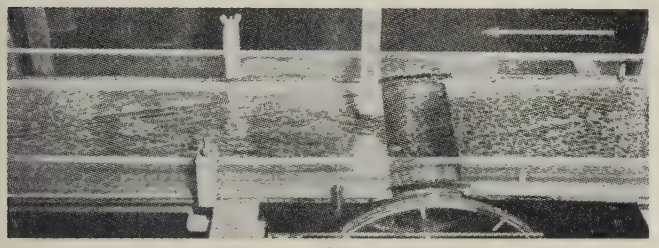
When this is combined with equation (35), with $R^{-1}$ and higher order again neglected, one has

$$\frac{2m(r_0+d)}{d} = 2q\sqrt{1+C}\left\{3L + \frac{3\alpha E'}{\sqrt{R}} + P(L^2-1) + \sqrt{\frac{1+C}{R}}\left[2\alpha PL(L^2-1) - \left(L^2 - \frac{C}{C+1}\right)\alpha\right]\right\} \quad (39)$$

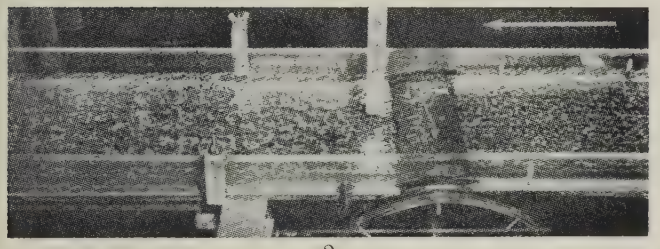
with

$$p = \frac{2m}{q}\sqrt{1+C}\,. \quad (40)$$

For three values of $r_0/d$, equations (38) and (39) jointly



1



2

3

***Plate I***

(1) $g' = 0$; $h = 0.2$ in.; $U = 3.4$ f.p.s.; flow is to the left. (2) $g' = 5.0$ g.; $h = 0.2$ in.; $U = 8.4$ f.p.s.; flow is to the left. (3) $g' = 14.0$ g.; $h = 0.2$ in.; $U = 13.3$ f.p.s.; flow is to the left.

define two relationships between $R$, $S(= T/\rho\omega^2 d^3)$, $m$, and $q$, so that if $R$ and $S$ are given the critical $m$ (or $m_{cr}$) and the corresponding $q$ can be found. The graphs for equations (38) and (39) are shown in Figs. 5 to 10.

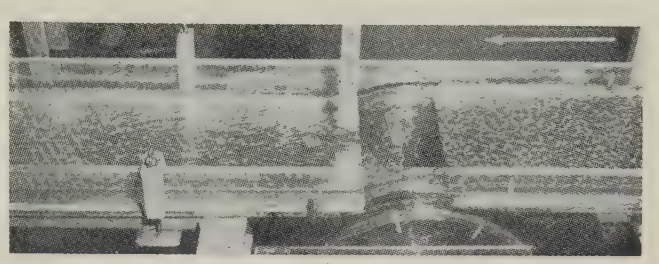
For values of $m$ greater than 3, $L$ is essentially unity. For very large Reynolds numbers the critical $m$ (for maximum $q$) is then, from equation (36),

$$m_{cr} = \left(\frac{\rho\omega^2 r_0 d^2}{3T}\right)^{1/2} = \left(\frac{r_0}{3dS}\right)^{1/2} \quad (41)$$

with the corresponding $q$ given very accurately by

$$q_{\max} = \left(\frac{2m_{cr}r_0}{3d}\right)^{1/2} = \left(\frac{4r_0^3}{27d^3S}\right)^{1/4} \quad (42)$$

privided $r_0/d$ is large. It is worthy of note that



1

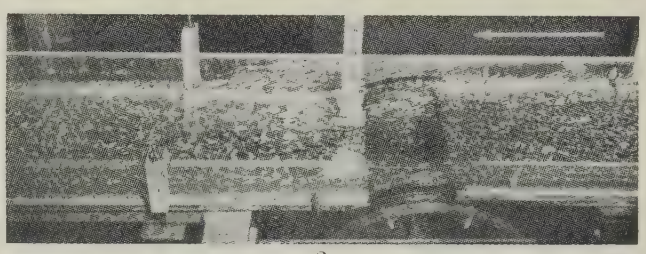


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***Plate II***

(1) $g' = 0$; $h = 0.4$ in.; $U = 3.4$ f.p.s.; flow is to the left. (2) $g' = 5.0$ g.; $h = 0.4$ in.; $U = 8.4$ f.p.s.,; flow is to the left. (3) $g' = 14.0$ g.; $h = 0.4$ in.; $U = 13.3$ f.p.s.; flow is to the left.

Figs. 6, 8, and 10 confirm equation (41), as they should, since they are constructed for large Reynolds numbers.

## CONCLUSIONS

From the foregoing sections it can be concluded that

1. The growth of disturbances in the fluid as it flows directly over the table rolls is essentially caused by the downward acceleration induced by the curvature of the wire as it wraps around the table rolls.

2. The growth of disturbances subsequent to the table rolls have been determined experimentally, with the results shown in Fig. 4. An adequate analysis is still lacking. The degree of wrapping of the wire around the table rolls has been found to have a great effect on the growth of the disturbances.

3. A detailed analysis has been performed by the first author for the formation of rings in a rotating liquid film with a free surface. Supporting experimental data are still to be collected.

ACKNOWLEDGMENT: The computational and drafting assistance rendered by Mr. Chintu Lai is greatly appreciated.

# Corrosion of Stainless Steel, Titanium, and Titanium Alloys by Ammonia-Base Sulphite Liquor

LYLE C. JENNESS

**Several types of stainless steel, titanium metal, and titanium alloys were subjected to pilot plant corrosion tests in neutral sulphite and ammonia-base acid sulphite liquors. As a result of these screening tests, type 316 stainless steel, two types of titanium metal, and two titanium alloys were subjected to acid sulphite liquor under commercial conditions of 24-hr. operation for many weeks. The samples were inspected at the end of 5, 7, and 11-week intervals of time. Both samples of titanium and titanium alloy showed much less loss in weight than did type 316 stainless steel. Photomicrographs indicate some progressive corrosion, and widening of attacked area, in the case of stainless steel and one titanium alloy. No change in surface structure of titanium metal was evident from the photomicrographs, and one of the titanium alloys showed very little progressive corrosion.**

WHEREAS much information is published on the resistance of steel, titanium, and various alloys to kraft cooking liquor, little if any is known to the author that pertains to the corrosion resistance of these alloys to acid sulphite cooking liquor. It was the purpose of this investigation to study the resistance to corrosion of a variety of such alloys under conditions comparable to acid sulphite pulping with ammonia-base liquor.

Preliminary tests were made in a laboratory digester which was operated to simulate commercial conditions. These alloys that looked most promising were then subjected to commercial conditions in a digester utilizing ammonia-base sulphite liquor.

## PROCEDURE

### *Laboratory*

Triplicate specimens of the alloys listed in Table I, and some alloys containing large amounts of copper, were assembled on a circular test rack of about 10 in. in diameter. The specimens were insulated from each other by means of Kel-F plastic tubing and teflon spacers. The test rack was suspended from a horizontal baffle plate on the cover of a digester in such a manner that essentially one-half of each specimen was immersed in cooking liquor, the other half being exposed to steam and gases.

Prior to being assembled on the rack, the specimens were degreased with carbon tetrachloride, scrubbed with pumice, thoroughly rinsed in hot water, dipped in alcohol, and air dried before being weighed. Each strip was also measured for surface area and was approximately 1 in. wide and 4 in. long.

The experimental digester used was of type 316 stainless steel construction and of about 2 cu. ft. capacity. It was charged with batches of about 8.0 lb. of softwood chips and 100 lb. of ammonia-base sulphite liquor. The liquor was approximately 6.0% total $SO_2$ and 1.0% mill combined $SO_2$ at the start of each cook. The chips were cooked until the pH of the cooking liquor was approximately 1.5. The digester was then allowed to cool and another batch of wood and liquor charged. Liquor was recirculated throughout the cook and ranged in temperature from 75 to 265°F.

Table I. Composition of Alloys

| *Sample* | *Composition, % by weight* |
|---|---|
| Iodide Ti (ITI) | C—0.068; O—0.007; N—0.007; Cu, Sn, and V—0.001–0.01; Mg—0.0001–0.001; Ti—balance |
| RC-55 | C—0.047; O—0.132; N—0.009; Fe—0.01–0.1; Cr, Cu, Mn, Mg, Ni, Si, Sn, and V—0.001–0.01; Ti—balance |
| 130-A | C—0.030; O—0.035, N—0.010; Mn—9.10; Fe—0.01–0.1; Al, Co, Cr, Cu, Ni, Si, Sn and V—0.001–0.01; Mg—0.0001–0.001; Ti—balance |
| Commercial Ti (CTI) | C—0.048; O—0.116; N—0.057; Mn—0.01–0.1; Al, Cu, Fe, Mg, Si, Sn, and V—0.001–0.01; Ti—balance |
| Stainless (316) | Cr—17.57; Ni—13.74; Mo—2.40; Mn—1.95; C—0.053; Si—0.034; Fe—balance |
| Stainless (347) | Cr—18.06; Ni—11.29; Cb—0.81; Mn—1.73; C—0.095; Si—0.44; Fe—balance |
| Inconel | Cr—16.04; Fe—8.60; Si—0.21; Cu—0.001; C—0.038; Ni—balance |

Visual examination of the specimens was made at the end of each cook and some samples were removed before the end of the test. The laboratory test was terminated after about 205 hr. of contact time, each remaining specimen was cleaned as previously described, weighed, and a rate of penetration calculated in inches per year from the loss in weight and known surface area and density of the specimens. Some of these results are given in Table II and will be discussed later.

### *Commercial*

Duplicate specimens of the more resistant alloys were bolted to a flat rack, each specimen being insulated from the rack by teflon spacers, after having been cleaned and weighed as described under the laboratory procedure. The rack was then welded to the inside of a stainless steel recirculating line leading from near the bottom of a commercial digester. The commercial process also utilized softwood and ammonia-base sulphite liquor. After exposure to the liquor for a certain number of days of continuous cooking the rack was re-

Table II. Calculated Penetration, $10^{-4}$ i.p.y.

| *Sample No.* | *24-hr. days of exposure* | | | |
|---|---|---|---|---|
| | *8.5*[a] | *35*[b] | *49*[b] | *77*[b] |
| ITI | 3.0 | 0.3 | 0.3 | 0.0 |
| RC 55 | .. | 0.2 | 0.4 | 0.3 |
| 130A | .. | 0.3 | 0.2 | 0.1 |
| CTI | 3.0 | 0.8 | 0.3 | 0.3 |
| SS 316 | 20.0 | 1.2 | 1.0 | 1.6 |

[a] Laboratory conditions.
[b] Commercial conditions.

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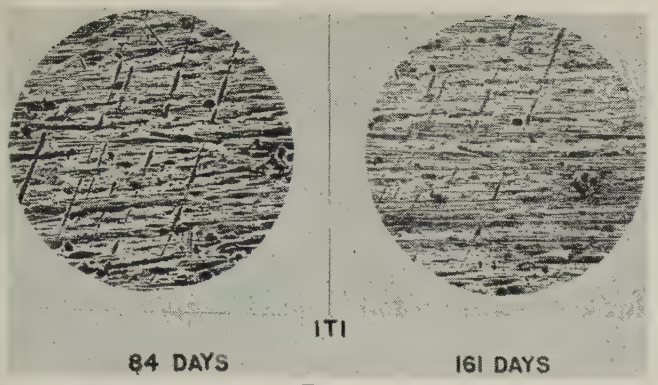


*Fig. 1*

moved, the specimens cleaned, and loss of weight determined. The average penetration in inches per year was then calculated as previously described.

## RESULTS

It was readily apparent early in the tests under laboratory conditions that the copper-base alloys tested, namely olympic bronze, aluminum bronze, phosphor bronze, cupro-nickel, monel, and copper itself were reducing sulphite to sulphide and thereby being corroded rapidly. These specimens were removed from the test rack early in the trial of 8.5 days. It is presumed that corrosion of the copper-base alloys was accelerated by the presence of ammonium bisulphite in the cooking liquor.

After 87 hr. exposure to the laboratory conditions the specimens of type 347 stainless steel were severely pitted and two of the three specimens had failed at the water line. Since type 302 stainless was more resistant to these conditions, and type 316 stainless still more resistant, it is presumed that the presence of columbium in type 347 stainless accelerated the pitting of it in ammonia-base sulphite liquor.

The Inconel specimens also appeared to be reducing the sulphite liquor and were removed from the rack after 44 hr. exposure from which time of contact calculated penetration of 0.273 i.p.y. resulted.

Two of the specimens of type 302 stainless were tarnished during the laboratory trial but showed an extremely low corrosion rate. The other specimen was pitted, particularly above the water line, and yielded a calculated penetration of 0.070 i.p.y. Spectrographic analysis of samples taken from each specimen failed to show any differences in composition which might account for the difference in behavior of those specimens.

The titanium and type 316 stainless steel specimens showed no visible corrosion in the laboratory test and calculated penetration in inches per year is tabulated for these specimens in Table II. Corresponding values for these samples, and two other titanium alloys, are listed in Table II for calculated penetration rates based on three periods of exposure to commercial cooking liquor.

It will first be observed from Table II that the laboratory conditions are more drastic than the commercial conditions. This situation may be due in part to the fact that in the laboratory test the specimens were half immersed in liquid and half exposed to vapors, whereas they were completely immersed under commercial conditions. Another factor might be the more severe cooking of wood chips in the laboratory and consequent higher concentration of organic acids from the wood.

The results in Table II also indicate that the specimens of titanium and titanium alloys tested are all more resistant than type 316 stainless steel is to these pulping conditions. Furthermore the low carbon-

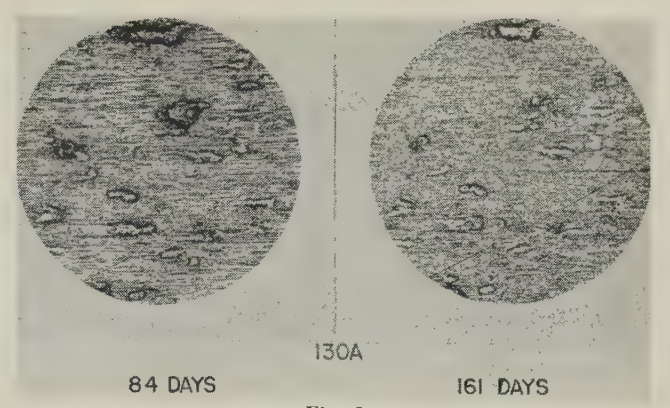


*Fig. 3*

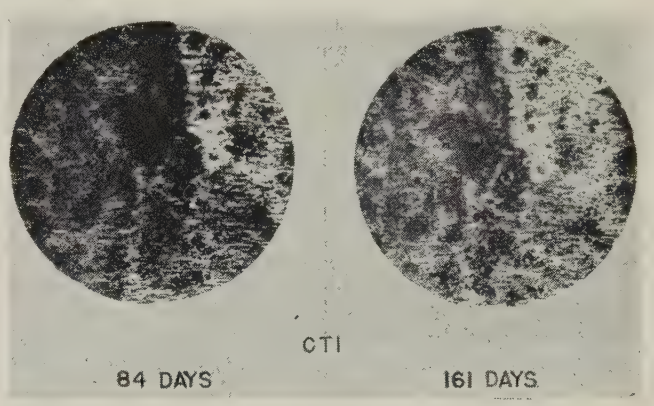


*Fig. 4*

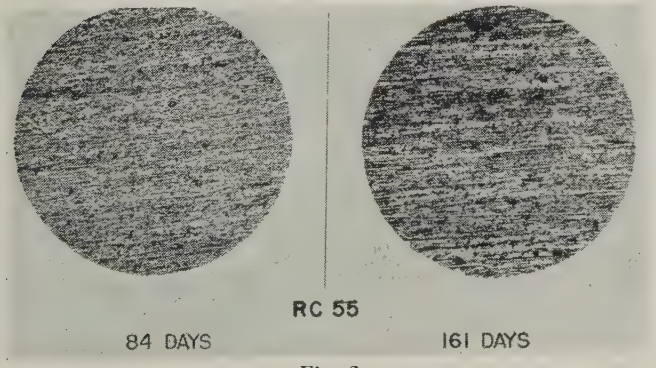


*Fig. 2*

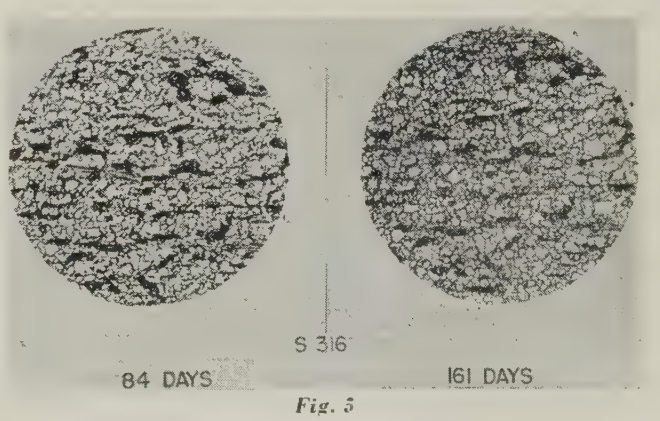


*Fig. 5*

manganese-titanium alloy (130A) and particularly the iodide titanium (ITI) appear to become more resistant to this corrosive action the longer they are subjected to it.

Figures 1 to 5 show photomicrographs of the same portion of each specimen tabulated in Table II after the 49 and 77-day periods of exposure to commercial cooking liquor. These pictures show no indication of surface corrosion of the iodide titanium or commercial titanium specimens. Figure 2 shows selective pitting of sample RC 55 with probable continued bordered pitting during the 77-day period. Figure 3 shows a possible slight pitting, and widening of the attacked area, at the left of the picture of specimen 130 A. Figure 5 shows rather uniform boundary attack of type 316 stainless steel and a widening of the boundary attack with continuation of time of exposure.

## CONCLUSIONS

1. Copper, bronze, and nickel alloys tested were rapidly corroded by ammonia-base sulphite cooking liquor.

2. All titanium and titanium alloys tested were superior to type 316 stainless steel from the standpoint of corrosion by ammonia base sulphite cooking liquor.

3. Of the specimens of titanium and titanium alloy tested iodide titanium (ITI) exhibited the best resistance to corrosion.

Presented at the Twelfth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Cincinatti, Ohio., 1957.

The author is grateful to the Chase Brass & Copper Co. of Waterbury, Conn., for supplying specimens of alloys and for analytical assistance, and to the Kennecott Copper Corp. of New York, N. Y. for sponsoring this investigation. He is also grateful to the Eastern Corp. of South Brewer, Me., for installation of the test rack in a digester that was used for commercial production of wood pulp.

# Testing the Tearing Resistance of Paperboard

H. W. VERSEPUT and W. R. NOISET

**It is generally recognized that the Elmendorf tear tester is not entirely satisfactory for the cross-direction tearing of cylinder papers and paperboards. Because of the grain characteristics of such materials, cross-direction tears seldom remain within the specified 10-mm. limits on deviation from the line of the initial slit. A number of simple remedies proposed by various people have all been found objectionable for one or more reasons. An attachment which permits use of the Elmendorf instrument to make a "torsion" tear has been found to be more successful. This test yields results of about the same magnitude as the regular Elmendorf, but of improved precision. In the conventional Elmendorf test of a cylinder paperboard, the width of the specimen has been found to have critical effect upon the result. Attempts to determine the effect of stiffness upon the tear test have been only partially successful, but the torsion test appears to be influenced by stiffness to a greater extent than does the conventional procedure.**

It is generally recognized that the present TAPPI Standard (T 414) for the internal tearing resistance of paper, using the Elmendorf instrument, is not very satisfactory for the testing of papers and paperboards made on cylinder machines. The marked grain characteristics of such materials will not permit valid cross-direction tears to be made.

The present method requires that the line of tear deviate no more than 10 mm. from the line of the initial slit. This is necessary because, while the instrument actually measures the work required to make the tear, this work is divided by the distance torn and read as average tearing force. If the line of tear deviates markedly from the intended direction, the length of tear becomes excessive, leading to falsely high results. Moreover, once this occurs, one is obviously measuring the tearing resistance in a direction other than that intended.

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Moreover, tear tests are empirical tests and are highly dependent upon the conditions under which they are made. It is readily apparent that in a test such as the Elmendorf, the result incorporates a number of factors which are measured as tear, but are actually something else.

In the testing of paperboards, for example, the sample tends to split apart over an extended area, rather than tearing neatly, so that on many occasions, the measurement is more nearly one of plybond strength.

The Elmendorf test is also strongly affected by the stiffness of the specimen, which can be considerable in the case of heavy caliper paperboards. In fact, many specimens are so stiff that they will not tear at all unless the standard augmenting weight is used. In some cases, the use of the weight brings the scale reading below the recommended minimum of 20, leading to further inaccuracies which, thus far, have been accepted as regrettable but inevitable.

## SUGGESTED SOLUTIONS

Many suggestions for improving control over the direction of tearing have been tried and discarded. Prebending of the specimen was ineffective. Provision of a vertical jaw extension to guide the tear made the tester inoperative. Of a variety of patterns of perforation, those which were at all effective in directing the tear so distorted the tear length and/or direction as to make the results meaningless.

It is possible to effect a slight improvement by cutting specimens $41\frac{1}{2}$ mm. long, rather than 63 mm. Thus the tear length is $21\frac{1}{2}$ mm., exactly half of the normal length. The improvement is not appreciable, and such a procedure frequently results in so lowering the scale reading as to seriously affect the accuracy of the result.

The abnormal length of errant cross-direction tears can be compensated for by measuring the actual length

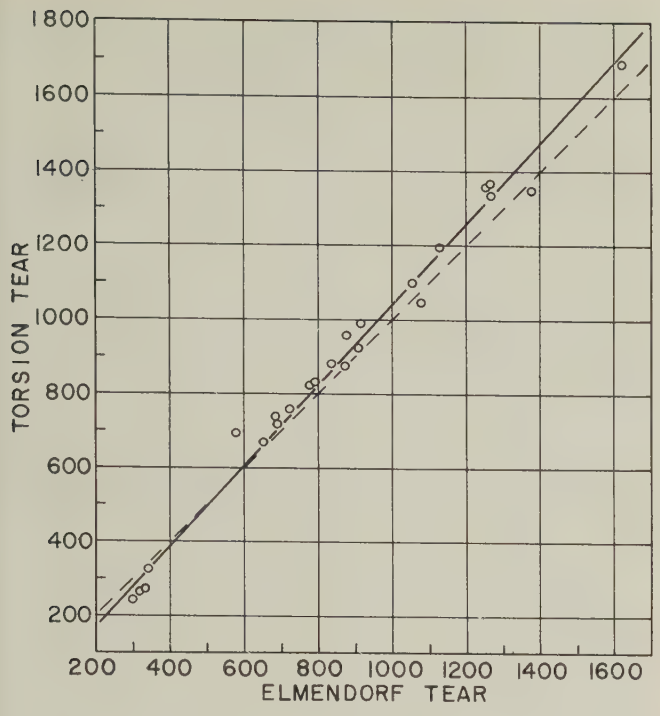


*Fig. 1. Results of cross-direction tests with torsion attachment, for 24 cylinder paperboards*

torn and adjusting the result accordingly. The same effect is achieved without measurements by cutting the specimens to a semicircular shape (actually a semicircle of 43 mm. radius, surmounting a 20 by 86 mm. rectangle. The end of the initial slit coincides with the center of the semicircle.) In this way, all tears are the same length, regardless of the direction they take. While neither of these procedures actually corrects the direction torn, the semicircular specimen technique was found to provide a slight improvement. In tests of 24 cylinder boards, the average direction of tear, using the conventional 63 mm. by 3-in. specimen, was found to be 55° from the true cross direction; this was reduced to 49° by use of the semicircular sample. Such test results were about 12% lower than those on the rectangular samples, and the coefficient of variation was lowered from 8.3% to 6.1%. The machine direction test was essentially unaffected by the change in specimen shape. While these are worthwhile improvements, 49° is still a marked deviation from the desired line of tear.

## THE TORSION PRINCIPLE

About a decade ago, The Institute of Paper Chemistry introduced the torsion tear tester as a solution to the problem. In this instrument, a notched rectangular specimen is clamped along its long edges. One clamp is then twisted through 90° or more on an axis in the plane of the specimen and passing through the middles of the clamped edges. One of the results of this action is a truer cross-direction tear than is possible with the Elmendorf instrument.

The torsion instrument was developed for the container industry, and has not been widely accepted in the boxboard field. In an effort to combine the advantages of the torsion type of test with the general acceptance of the Elmendorf results, the Thwing-Albert Instrument Co. has designed an atttachment which permits torsion type tears on the Elmendorf instrument. The jaws and sample size are so arranged that the total length torn is the same as in the conventional Elmendorf test.

Tests of this procedure on 24 different cylinder boards yielded slightly lower machine-direction results than the conventional Elmendorf procedure; the coefficient of variation was about the same. In the cross direction there was the somewhat surprising conclusion that the torsion and conventional results were virtually identical, as shown in Fig. 1. The dispersion was improved somewhat further over that of the semicircular specimens, being 4.9%—a figure which probably approached the variability of the samples themselves.

The lower machine-direction result may be due to a decrease in the stiffness effect. The cross-direction result is somewhat more complicated to explain, as it appears to be a combination of several factors. By forcing the tear to proceed in the desired path, the length of tear was reduced from the excessive distance usually travelled by cross-direction tears to that for which the instrument was designed. This results in a reduction in the indicated tearing strength. However, in a normal Elmendorf cross-direction tear, the tear proceeds at something like a 45° angle because this is the path of least resistance. Therefore, if the tear is forced to proceed along the true cross direction, the indicated tearing strength would be expected to be higher. Apparently the two tendencies nearly balanced in the boards tested. The stiffness effect, which appears to be different in the two types of tests is probably also a factor.

If the torsion test yields approximately the same results as the conventional procedure, there is little advantage in using it. Therefore, it appeared desirable to investigate further the nature of the tearing test with respect to paperboard.

## EFFECT OF SPECIMEN WIDTH

Since the least understood factor in the tear test is

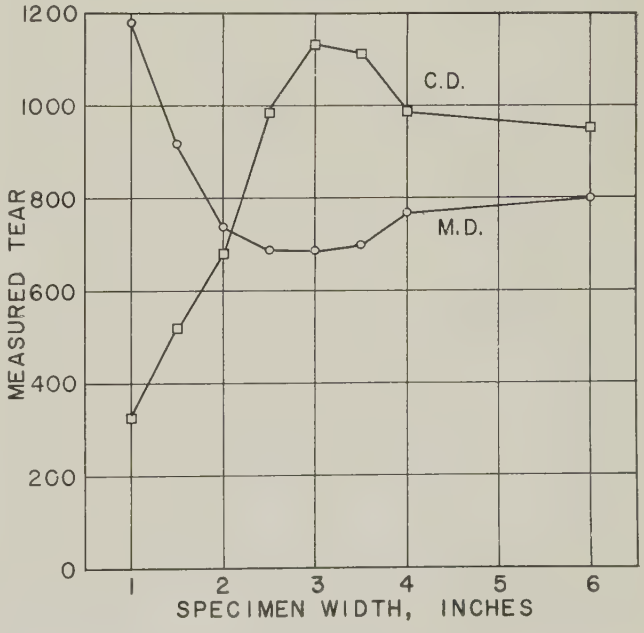


*Fig. 2. Effect of specimen width on measured tear of 0.032 white-lined kraft cylinder board*

that of stiffness, effort was concentrated in this direction. In a preliminary attempt to vary stiffness without changing the inherent tearing strength of the specimens, the specimen width was varied, with the somewhat unexpected results shown in Fig. 2. Each point represents the mean of five tears of a 0.032 white-lined kraft cylinder board. As the width of machine-direction specimens was increased, the measured tearing resistance increased as expected, although not with sufficient regularity to be amenable to analysis. When the width was decreased, the measured tearing strength increased markedly, contrary to expectations. Careful observation of the tests in progress showed that several actions were occurring. The narrower specimens were more severely distorted when torn, which could account for an increased amount of flexure work. So violent was the flexure that the top edge often contacted the bearing support. There was also an increased amount of twisting of the specimen. All of these effects apparently contribute to the result.

The drastic reduction in results as the width of the cross-direction specimens was decreased appeared to be due very largely to an increasing tendency for the tear to pass through the end of the specimen, coupled with the decreasing distance from the initial slit to the end. The more moderate decrease as the specimen width was increased appeared to be due to a lessening in the deviation from the center line, resulting in a shorter length of tear, together with a decreased tendency to delaminate. These last are steps in the desired direction, but even in a 6-in. sample, the tear deviation was 20 mm., twice that allowable.

Two conclusions were drawn from this experiment:

1. Varying the specimen width is not an effective means of studying the effect of stiffness upon the tearing test.

2. The width of tearing strength specimens of paperboard must not vary from the specified 3 in. The frequently encountered short-cut of making several tears in wide specimens may be suitable in paper testing, but should not be permitted where stiffer materials are involved.

## EFFECT OF STIFFNESS

In making a more direct attack on the stiffness problem, it was desired to test materials having essentially the same inherent resistance to tearing, but varying in stiffness. This condition was approached by making laminations of thin boards. Similar laminations were split apart at the glue lines immediately after laminating so that the adhesive dried without adhering the plies together. This procedure yielded four sets of sample pairs comprising two, three, four, and five-ply laminations with and without ply adhesion. It was reasoned that the inherent tearing resistance would not be greatly affected by the lamination, whereas the stiffness was markedly increased. This reasoning necessarily neglects possible effects of ply interaction on tearing resistance, but it is thought that this is relatively minor.

These specimens were tested for both tearing resistance and Taber stiffness. Analysis of the data was based upon the following reasoning:

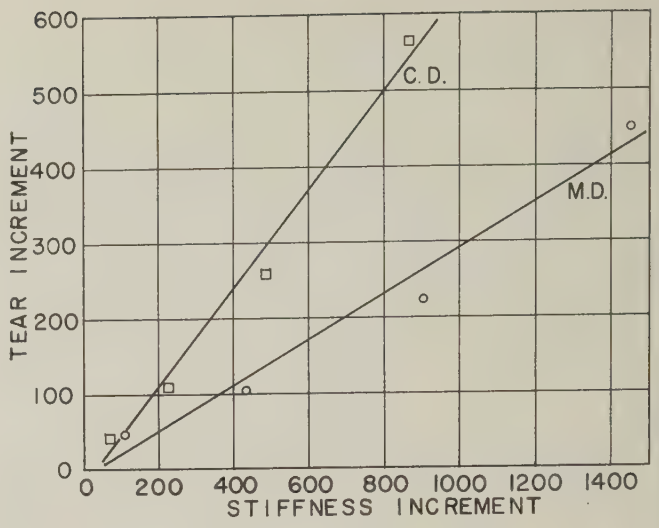


*Fig. 3. Relationship between stiffness and torsion tear of multiple plies of 0.009 fourdrinier corrugating medium*

Assuming that the measured tearing resistance consists of two additive components,

$$T_m = T_i + T_s \qquad (1)$$

where

$T_m$ = measured tearing resistance,
$T_i$ = intrinsic tearing resistance (i.e., "pure" tear), and
$T_s$ = additional effect due to stiffness.

Assuming further that the stiffness effect is directly related to the stiffness of the sample as measured, in this case, by the Taber instrument,

$$T_m = T_i + (K \times S) \qquad (2)$$

where

$K$ = a constant and
$S$ = Taber stiffness of sample (in the same direction as the tear).

Thus, for a given pair of samples

$$T_m = T_i + (K \times S), \text{ and}$$
$$T_m' = T_i' + (K \times S')$$

where the primed symbols refer to the laminated sample and the unprimed symbols refer to the unlaminated sample.

Combining these two equations,

$$T_m' - T_m = T_i - T_i' + K(S' - S) \qquad (3)$$

Since $T_i = T_i'$,

$$T_m' - T_m = K(S' - S) \qquad (4)$$

In this equation, $T_m' - T_m$ is the *increment* in tear resulting from the lamination, and $S' - S$ is the increment in stiffness.

From such an experiment using a 0.009 fourdrinier bogus corrugating medium, the following $K$'s were calculated for machine-direction tears:

Elmendorf tear: $K = 0.233$
Torsion tear: $K = 0.302$

For cross-direction tears, the $K$'s were higher, being 0.298 and 0.655, respectively. As an example, the experimental points and regression lines for torsion tears are shown in Fig. 3.

However, for a similar experiment involving a 0.008 fourdrinier bleached sulphate board, the constant for machine direction Elmendorf was 0.378. This

suggests that $K$ is not as constant as might be desired, which of course, signifies that the actual relationship is not as simple as the one assumed.

Actually, of course, the whole situation has been oversimplified. There are a number of factors involved other than stiffness, *per se*. It is known, for example, that the torsion type of tear involves a certain amount of stretching of the specimen. In this simplified analysis, this would show up as an effect of stiffness.

Furthermore, it would seem, intuitively, that the torsion test, because of its nature, would be more affected by the stiffness in the direction at right angles to that of the tear than by that in the tearing direction. It is very likely that both types of test are affected by stiffness in both directions. A considerably more extensive series of experiments on materials of various degrees of directionality would be required to test this.

## CONCLUSIONS

One fact is apparent; the torsion test is more severely affected by stiffness than the conventional Elmendorf method. This provides additional insight into the relationship between the results of the two tests, which was shown in Fig. 1. The Elmendorf result contains a component caused by excessive tear length and delamination; the torsion test does not involve these items but does contain a component due to inability of the tear to follow the path of least resistance. If the latter is somewhat the smaller of the two, the greater effect of stiffness could, in the middle of the range, just balance out the difference. Then, thinner, more flexible specimens would yield a torsion result somewhat lower than the Elmendorf result, while for thicker, stiffer specimens the opposite would occur, as shown in Fig. 1.

It must be concluded that the ideal procedure for testing the cross-direction tearing resistance of cylinder boards is not yet available. The torsion attachment for the Elmendorf tester holds promise for the future. Suggestions for further investigation will be gratefully received.

PRESENTED at the Ninth Testing Conference of the Technical Association of the Pulp and Paper Industry, Savannah, Ga., Sept. 30–Oct. 3, 1958.

The authors wish to thank Ralph Green and the Thwing-Albert Instrument Co. for designing and building the torsion attachment to the Elmendorf tear tester and for making the prototype available for an extended period of evaluation. Thanks are also due to H. A. Birdsall of the Bell Telephone Laboratories for supplying cylinder-made tissues for preliminary testing, to all those who made helpful suggestions, and especially to the Continental Can Co. for the time and facilities with which to accomplish this work.

# Carbon-14 Labeled Wood Cellulose

A. A. SELDERS, B. A. STASKIEWICZ, and JEAN P. PICARD

**Radioactive labeled wood cellulose has been prepared *in vivo* by injecting young pine trees with $C^{14}$ aqueous sodium carbonate solutions, and by exposing the young trees to a controlled and contained atmosphere of $C^{14}$ carbon dioxide. The trees treated with radioactive material during the growing season, have been hewn, and a comparative distribution of radioactivity in various parts such as roots, trunk, branches, foliage, bark, and individual growth rings has been determined; also small quantities of "tagged" cellulose has been prepared for further studies of reactions occurring in the viscose process. Scintillation counts and autoradiographs indicate that labeling occurring during growth involved both diffusion and laydown of radioactive material through the flow of sap. However, the level of activity between the holocellulose samples extracted from the growth ring containing the highest concentration of radioactive material were quite markedly higher for the injected trees than for the exposed trees. Evidence is also presented which indicate that the radioactive carbon has become an integral part of cellulose molecular structure and of all related elements such as glucose, mannose, and xylose.**

ALTHOUGH $C^{14}$ has been available as a tracer tool for several years, a survey of the literature shows no attempt to use it in tree growth processes for the preparation of tagged wood cellulose. In 1954, Freudenberg (*2*), in Germany, working on the biosynthesis of lignin, treated a series of 4-year old spruce trees by injecting them under the bark with radioactive coniferin. Freudenberg measured the extent of movement of the active material and found that it had moved a few centimeters up and down from the point of injection. Furthermore, he claimed that within 2 years, over 90% of radioactive substance had properties similar to lignin. The isolation of labeled wood cellulose was not reported.

On the other hand, the preparation of cotton cellulose tagged with $C^{14}$ was reported as early as 1950, when Calvin (*1*) employed radioactive carbon dioxide ($C^{14}O_2$) to investigate the chemical transformation of the carbon atom of the $CO_2$ into carbohydrates during the photosynthetic process.

Greathouse (*3*) in 1953, studying the biosynthesis of cellulose, has obtained labeled cotton cellulose by injecting $C^{14}$-glucose into the maturing cotton bolls. In the following years, Minor, *et al.* (*5*), demonstrated that cellulose labeled with $C^{14}$ could be synthesized by microorganisms.

## OBJECTIVES

The present radioisotope experimental work has two main objectives. The first is the use of radioisotopes in connection with wood-growth investigations and nutrient uptake to study the progression pattern of active material through the tree following injection. This, we expect, will lead to a better understanding of the growth mechanism and eventually to more effective use of nutrients in stimulating tree growth. The second objective is the preparation of a sufficient quantity of wood cellulose tagged with $C^{14}$ to be employed in connection with cellulose structure investigations, solution behavior studies, and in the pioneering of new means for evaluating mechanisms of reactions encountered during the conversion of cellulose into its end-products.

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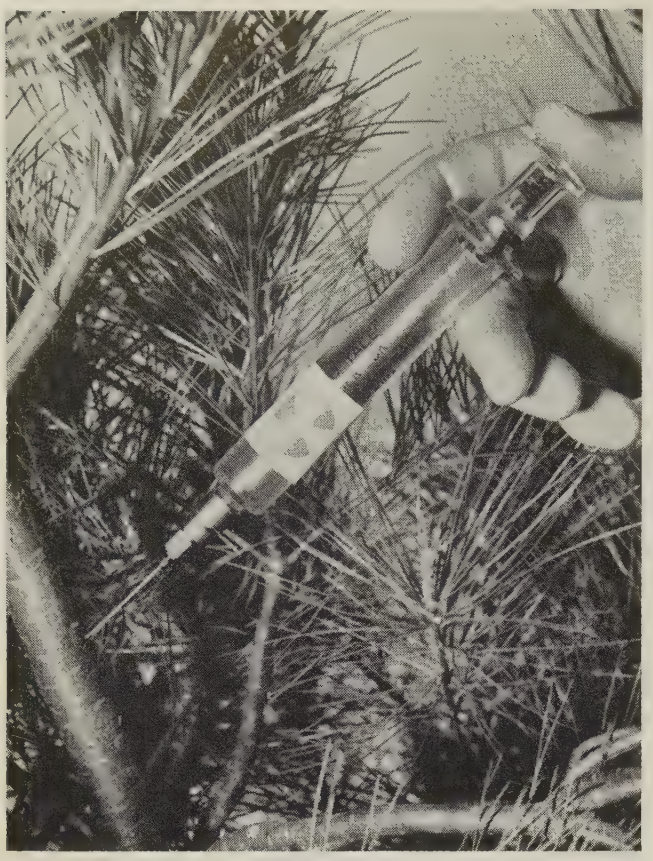

*Fig. 1. Injection of tree*

This paper describes the preparation of radioactive labeled wood cellulose *in vivo*, quantitative assays of the radioactivity distribution throughout the treated trees, the isolation of the radioactive cellulose, and the demonstration that the radioactive carbon has become an integral part of the newly formed cellulose molecule.

## PREPARATION OF CARBON-14 TAGGED WOOD CELLULOSE

Both aqueous salt injection (Fig. 1) and gaseous exposure were used in these experiments. In the injection method, young pine trees were injected in the cambium with $C^{14}$ aqueous sodium carbonate solution. In the exposure technique, pine trees were exposed to an atmosphere containing controlled amounts of $C^{14}$ carbon dioxide. Both treatments were made with small repetitive doses of radioactive material during the growing season. The total quantity of radioactive carbon applied was approximately 0.5 millicurie for the injected trees and for the exposed trees.

## EXPERIMENTAL

### *Counting Technique*

The counting data were obtained by means of the Tri-carb liquid scintillation spectrometer (*6*). The photo multiplier tubes and sampling system are housed in a commerical deep freeze, maintained at −15°C.

Since the materials to be counted (sawdust, leaves, roots, etc.) were insoluble in liquid scintillators, these materials were ground to micron sized particles with the aid of a Wiley mill and suspended in a liquid scintillator which was used in the form of a gel. The gel scintillator consisted of *p*-bis-2-(5-phenyloazolyl)-benzene (POPOP) and 2,5-diphenylaxozole, PPO dissolved in toluene to which thixcin had been added (*1*). Thes uspended samples were counted in 5-dram crystallite screw-neck vials. Exactly 25 ml. of gel scintillator were added to the vial containing 20 to 100 mg. amounts of $C^{14}$-material.

Prior to actual counting of the radioactivity in the bark, roots, leaves, etc., the optimum counting conditions had to be determined. This was done by adding successive small increments of the control materials which were nonradioactive and determining their effect upon an internal standard at various pulse height discriminator and high voltage amplification settings. These data are experimentally determined by counting a fairly active standard through successive 10-v. windows, throughout the range of the discriminators (up to 100 v.) at various taps of high voltage.

The optimim counting conditions were given by the high-voltage curve which had the largest area under it in a window which was bounded below by the lowest discriminator voltage and bounded above by that voltage beyond which the sample counts were insignificant as compared to the background counts. Furthermore, the lower and upper discriminator settings were selected so that the ratio of sample counts through 10-v. windows at the two gates are the same as the ratio of the gate voltages to each other. In the case of the ground wood, the optimum counting conditions were found to be at 1180 v. with discriminator set at 10 to 100 v.

### *Autoradiographs*

The following procedure was followed for the preparation of the autoradiographs. Sections of the trees were cut into small blocks and were placed in a killing and fixing solution for 24 hr. (water 35, ethanol 50, glacial acetic acid 5, and formaldehyde 10). After adequate washing the blocks were sectioned with a microtome, sections 80 mu thick being obtained. These sections were stored in 50% ethanol as they were cut. When needed, these sections were placed between two microscope slides and dried at 150°C. for 12 hr. The dry sections were then wrapped with a piece of mylar film, and placed in contact with x-ray film for a

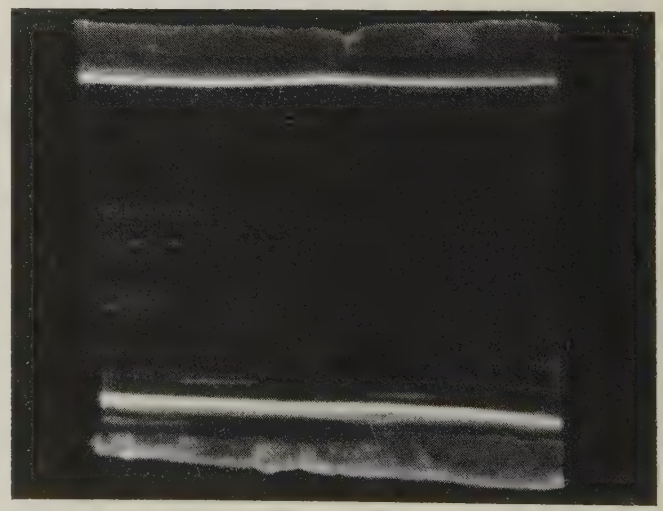

*Fig. 3. Autoradiograph of longitudinal section of tree injected with $Na_2C^{14}O_3$ solution*

**Table I. Distribution of Radioactivity in Various Growth Rings of Treated Pine Trees**

| *Longitudinal yearly growth increment* | *$C^{14}$ injected trees, c.p.m./100 mg. of sawdust[b] — Yearly growth rings no.* | | | | | | *$C^{14}$ exposed trees, c.p.m./100 mg. of sawdust[b] — Yearly growth rings, no.* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *1* | *2* | *3* | *4* | *5* | *6* | *1* | *2* | *3* | *4* | *5* | |
| A (top) | 1050 | ... | ... | ... | ... | ... | 2500 | ... | ... | ... | .. | ... |
| B | 382 | 1010 | ... | ... | ... | ... | 1188 | 1402 | ... | ... | .. | ... |
| C | 198 | 93 | 4040 | ... | ... | ... | ... | ... | ... | ... | .. | ... |
| D[a] | 2200 | 2245 | 2285 | 1074 | ... | ... | 438 | 573 | 476 | 1985 | .. | ... |
| E | 373 | 95 | 238 | 509 | 1306 | ... | ... | ... | ... | ... | .. | ... |
| F[a] (bottom) | 9950 | 3260 | 4470 | 2270 | 5340 | 2020 | 372 | 105 | 69 | 57 | 75 | 2190 |

[a] Injected areas. [b] 20-mesh material.

period of 17 days. At the end of the exposure period the x-ray film was developed with a fine grain photographic developer. This was found to be preferable to x-ray developer for greater details.

***Distribution of Activity***

Six months after exposure and injection the trees were hewn along with untreated controls and their various parts such as roots, trunk, branches, foliage, and bark qualitatively surveyed for the presence of radiation by means of the autoradiograph technique (with results as shown in Figs. 2 and 3) one being a longitudinal section, the other a cross section of a tree trunk taken some distance from the injection site. Other similar autoradiographs indicate that lay-down of radioactive material occurred in both types of radioactive treatments, although, the activity in the injected trees appeared to be at a considerably higher level than in the trees exposed to active carbon dioxide.

The outermost ring (latest growth) contained the highest amount of activity, as would be expected because of flow of sap in this functioning tissue. The inner rings, as well as the bark, showed some activity but in comparatively small traces.

The results of this preliminary survey, based on simple exposure to x-ray film, indicated that a quantitative determination of the distribution of the activity throughout the various sections of the trees would be of significance. This was done by means of liquid scintillation counting.

To achieve this, various parts of the trees were carefully dissected, extracted, and dried at 100°C. for several hours, ground to 20-mesh, and suspended in a solution of toluene containing an adequate phosphor and a suitable suspending agent.

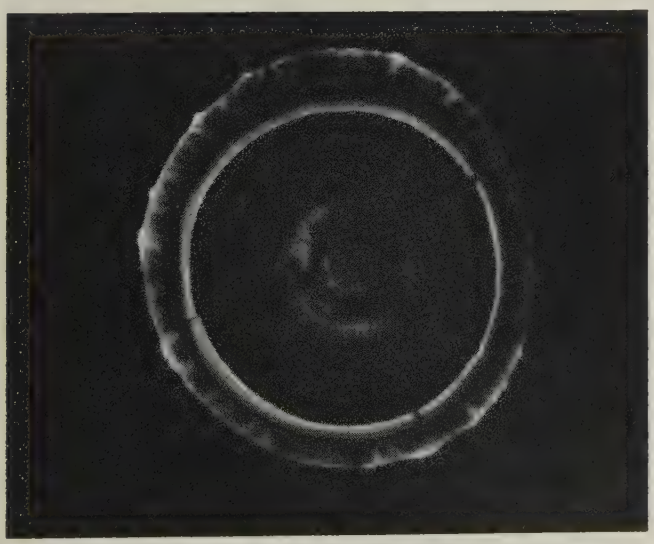

***Fig. 2. Autoradiograph of cross sections of tree injected with $Na_2C^{14}O_3$ solution***

***Fig. 4. Dissection of active ring in tree cross section***

As indicated in Table I, the outermost rings appear to have the highest degree of activity, except, however, for section "D" and "F" of the injected tree. The relatively high activity encountered in the innermost rings of these sections may be correlated with the fact that these sections were taken near the areas where the injections were made. Furthermore, this is borne out by the fact that in the case of the exposed tree no such abnormality has been detected (Table I). These results confirm the conclusions previously reached in the autoradiograph survey, namely, that most of the movement of the radioactive material had occurred during growth and as a result of growth, not by simple diffusion.

Additional measurements have been carried out to measure the amount of radioactivity present in other

**Table II. Radioactivity in Various Parts of the Tree**

Material: 20-mesh
Gates: 10–100

| *Material* | *$C^{14}$ injected* — *C.p.m. per 100 mg.* | *$C^{14}$ exposed* |
|---|---|---|
| Bark | 1326 | 800 |
| Roots | 708 | 493 |
| Foliage | 482 | 1210 |

parts of the injected and exposed trees. In both cases the roots, branches, foliage, and bark have been found to contain an appreciable level of activity as indicated in Table II.

### *Preparation of Active Holocellulose*

Holocellulose was prepared according to a method previously described by E. L. Lovell (*4*). The method consists of a series of digestions repeated each time with fresh acidified aqueous chlorite solution.

The radioactive treated trees along with the control were carefully dissected (Fig. 4) with the aid of a microscope in such a manner as to separate the different annual growth rings. This wood, in turn, was cut into small chips, 1 by 1/8 in. approximate size. Uniform wood chips were cooked in the chlorite digester liquor to remove the lignin.

This isolated holocellulose, after adequate washing, was separated into fractions. Table III gives the relative percentages of the various cellulose fractions obtained as well as the yield of holocellulose.

**Table III. Distribution of Radioactivity in Holocellulose Fraction Prepared from Treated Pine Trees[a]**

| *Cellulose fraction* | *$C^{14}$ injected tree* | | *$C^{14}$ exposed tree* | |
|---|---|---|---|---|
| | *Percentage* | *C.p.m./100 mg.* | *Percentage* | *C.p.m./per 100 mg.* |
| Alpha | 77.9 | 5,975 | 78.2 | 2099 |
| Beta | 0.8 | 18,900 | 0.9 | 3358 |
| Gamma | 21.3 | 8,100 | 20.9 | 826 |
| Holocellulose | 100. | 7,700 | 100. | 2008 |

[a] Yield of holocellulose 62% based on wood.

### *Determination of Level of Radioactivity in Labeled Holocellulose*

Each cellulose fraction was evaluated for radioactivity. The results obtained (Table III) indicate that cellulose fractions isolated from both trees vary in their respective level of activity. The beta and gamma-fractions for the injected tree were higher than the alpha-fraction which, in turn, was lower in activity than the holocellulose. In the case of the exposed tree, the beta-fraction is again slightly higher than the alpha-fraction which is of comparable intensity with the holocellulose, and the gamma-fraction was lower than the alpha-fraction. The amount of beta associated with the "tagged" holocellulose may suggest sensitivity to depolymerization due to "tagging," i.e., activation of certain sensitive sites, but will require much further investigation to clarify.

**Table IV. $C^{14}$ Injected Tree Radioactivity in Prepared Holocellulose**

Material: 20-mesh holocellulose
Gates: 10–100

| *Section designation* | *C.p.m. per 100 mg. of holocellulose* |
|---|---|
| Innermost ring, old growth | 395 |
| Outermost ring, new growth | 7700 |
| Other, intermediate | 270 |

The level of activity for holocellulose samples originating from new ring growth of treated trees were quite markedly higher than from older growth areas, as would be expected (Table IV). These count data are fully in agreement with the previous autoradiograph findings reported in connection with our work on raw wood samples; and it also gives additional support to the hypothesis that the radioactive carbon has become an integral part of the cellulose molecule.

In order to further substantiate this hypothesis, the holocellulose from the wood of the outer growth ring has been hydrolyzed to simple sugars. The glucose, xylose, and mannose fractions have been separated chromatographically in relatively pure form. Subsequent scintillation counting and autoradiograph survey have shown that radioactivity is present in all of these carbohydrate fractions, Table V, thereby giving confirmation to actual labeling.

Incident to these studies, "tagged" wood was also submitted to acid hydrolysis. The nonsoluble portion which was primarily lignin was separated and found also to be radioactive.

### *Viscose Processing of Radioactive Cellulose*

It was of interest to us to establish the fate of the activity in labeled cellulose when converted into viscose and subsequently regenerated. To this end, a viscose solution has been prepared from which a film was cast, and the degree of activity measured. These experimental results have demonstrated that labeled cellulose can well be used in pioneering work on mechanisms encountered in the field of wood cellulose chemistry and subsequent conversions to end-products such as rayon, tire cord, cellophane, and sponges.

**Table V. $C^{14}$ Injected Pine Tree Radioactivity of Constituent Sugars in Holocellulose[a]**

Material: 20-mesh
Gates: 10–100

| *Monosaccharide* | *C.p.m. per 100 mg.* |
|---|---|
| Glucose | 2050 |
| Xylose | 2131 |
| Mannose | 1830 |

[a] Holocellulose prepared from most active ring growth.

## CONCLUSIONS

In conclusion, it has been demonstrated that wood cellulose tagged with $C^{14}$ of sufficient high activity as to be easily counted can be prepared by simply injecting trees with small doses of aqueous solution of $Na_2C^{14}O_3$, or by exposing these trees to an atmosphere of $C^{14}O_2$.

Evidence has also been presented indicating that the radioactive carbon has become an integral part of the cellulose molecular structure and of all related elements, such as glucose, xylose, and mannose.

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Contribution No. 42 from the Research Department of Rayonier Inc.

Received Feb. 20, 1959. Presented before the Joint Divisions of Carbohydrate and Cellulose Chemistry, 134th Meeting, A.C.S., Chicago, Ill., Sept. 7–12, 1958.

# Polyoxyalkylene Polyols in High-Solids Coating Colors

A. DAMUSIS, J. W. COMPTON, and C. W. LEAF

**The effect of polyols which are block polymers of propylene oxide and ethylene oxide on the consistency of paper coating colors was studied by (1) determining the viscosities of the colors and comparing with a standard under varied conditions, and (2) by investigating the flow characteristics of the colors at high shear rates. It was found that the viscosity and flow characteristics differed according to the hydrophilic-hydrophobic ratio of the polyol. Polyoxyalkylene polyols with a low hydrophilic ratio are more effective than high hydrophilic ratio products in (1) lowering the viscosity and stabilizing starch-styrene butadiene latex and starch-polyvinyl acetate latex colors, (2) reducing the viscosity of colors containing protective colloids, and (3) appearing to promote laminar flow, reducing viscous drag and giving a lower torque at high rates of shear. Polyols with a low hydrophilic ratio tend to increase the viscosity of starch-acrylic colors particularly on aging.**

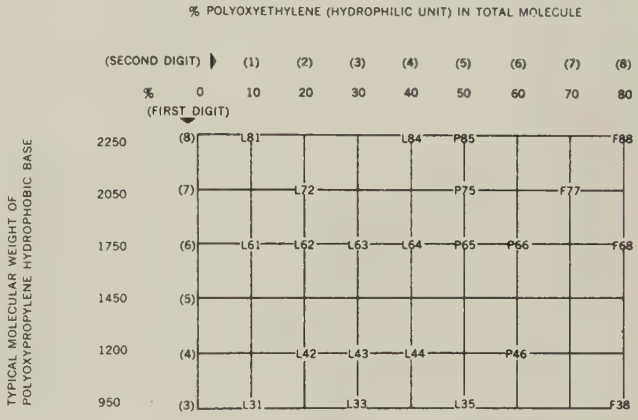
% POLYOXYETHYLENE (HYDROPHILIC UNIT) IN TOTAL MOLECULE
(SECOND DIGIT)
(1) (2) (3) (4) (5) (6) (7) (8)
% 0 10 20 30 40 50 60 70 80
(FIRST DIGIT)
TYPICAL MOLECULAR WEIGHT OF POLYOXYPROPYLENE HYDROPHOBIC BASE
2250 (8) L81 L84 P85 F88
2050 (7) L72 P75 F77
1750 (6) L61 L62 L63 L64 P65 P66 F68
1450 (5)
1200 (4) L42 L43 L44 P46
950 (3) L31 L33 L35 F38

*Fig. 1*

INCREASED paper production made possible by modern papermaking technology has placed new demands on coating colors. The inclusion of latices in paper coating colors, the trend toward higher total solids and the use of high-speed machine coaters are some of the factors which contribute to present day problems.

The desire to maintain low viscosities and to control the flow characteristics of colors has led to the evaluation of a number of additives with varying degrees of success. Wyandotte Chemicals Corp. manufactures a versatile series of polyoxyalkylene polyols which have found utility as dispersants and in other applications in the paper industry. However, no systematic investigation of the performance of these products in coating colors has been reported. This investigation was made to determine the effect of polyols on the stability, viscosity, and flow characteristics of paper coating colors.

## THE PLURONIC POLYOL GRID

Wyandotte Chemicals Corp. has developed a series of block polymers called Pluronic* polyols. These block-polymers are prepared by, initially, adding propylene oxide to the two hydroxyl groups of a propylene glycol nucleus. The molecular weight of the resulting hydrophobic base can be controlled as desired; useful bases vary in molecular weight from 800 to several thousands. By adding ethylene oxide to this hydrophobic base, hydrophilic polyoxyethylene groups are put on both ends of the molecule. These hydrophilic groups are controlled in length to constitute from 10 to 90% of the final molecule.

These polyols are unique in that both hydrophobic base and hydrophilic units can be varied as well as the ratio of one to the other. The molecular weight range is from 1000 to 11,000; physically the polyols vary from mobile liquids to solids sufficiently hard to be flaked. A graphic representation of this series of polyols formed by plotting molecular weight ranges of the hydrophobic base against the per cent of the hydrophilic unit in the final molecule is shown in Fig. 1. This arrangement is the Pluronic polyol grid.

## PLURONIC POLYOL NOMENCLATURE

To simplify the naming of the polyols, they are identified by a letter (L, P, or F) and a two-digit number. The letter identifies the physical form of the particular polyol: L for liquid, P for paste, and F for flake. The first digit identifies the typical molecular weight of the hydrophobic base, as indicated by the column at the left of the grid. The second digit, at the top of the grid, suggests the approximate per cent of ethylene oxide in the total molecule.

As an example, Pluronic F-68 is a flaked solid. The hydrophobic base has a molecular weight of approxi-

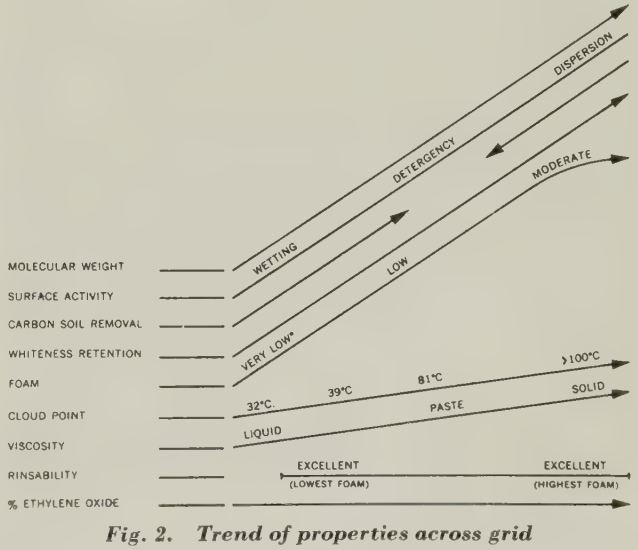


*Fig. 2. Trend of properties across grid*

* Reg. U. S. Patent Office.

A. DAMUSIS, Section Head, Industrial Applications, J. W. COMPTON, Supervisor, Industrial Applications, and C. W. LEAF, Supervisor, Inorganic Research, Research Div., Wyandotte Chemicals Corp., Wyandotte, Mich.

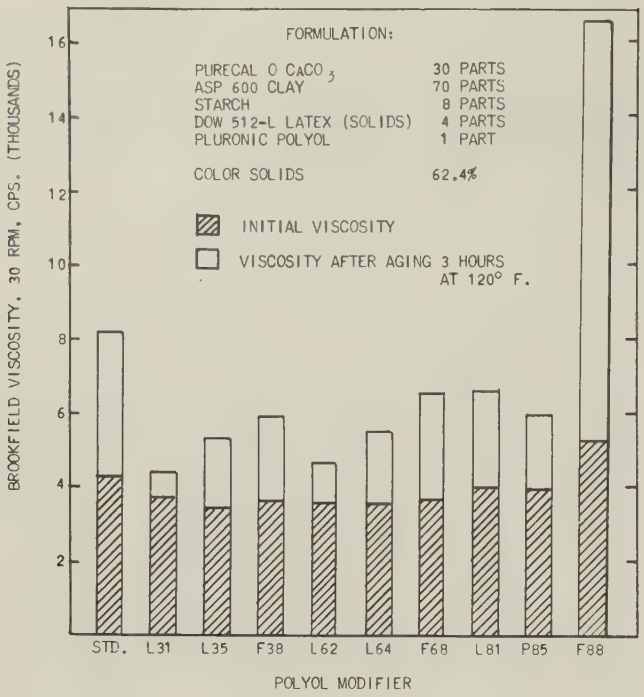
FORMULATION:
PURECAL O CaCO3 30 PARTS
ASP 600 CLAY 70 PARTS
STARCH 8 PARTS
DOW 512-L LATEX (SOLIDS) 4 PARTS
PLURONIC POLYOL 1 PART
COLOR SOLIDS 62.4%
INITIAL VISCOSITY
VISCOSITY AFTER AGING 3 HOURS AT 120° F.
BROOKFIELD VISCOSITY, 30 RPM, CPS. (THOUSANDS)
STD. L31 L35 F38 L62 L64 F68 L81 P85 F88
POLYOL MODIFIER

*Fig. 3. Effect of Pluronic polyols on the viscosity of starch-styrene butadiene latex coating colors*

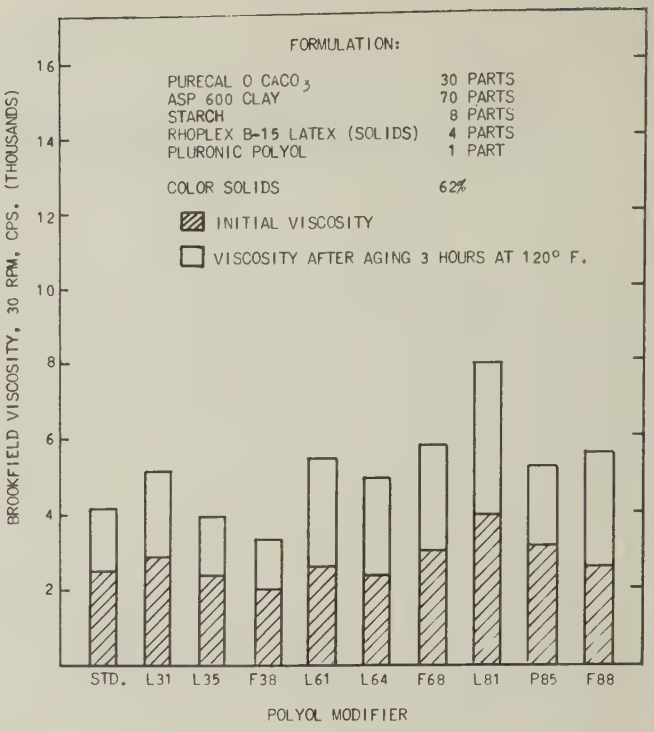
FORMULATION:
PURECAL O CaCO3 30 PARTS
ASP 600 CLAY 70 PARTS
STARCH 8 PARTS
RHOPLEX B-15 LATEX (SOLIDS) 4 PARTS
PLURONIC POLYOL 1 PART
COLOR SOLIDS 62%
INITIAL VISCOSITY
VISCOSITY AFTER AGING 3 HOURS AT 120° F.
BROOKFIELD VISCOSITY, 30 RPM, CPS. (THOUSANDS)
STD. L31 L35 F38 L61 L64 F68 L81 P85 F88
POLYOL MODIFIER

*Fig. 4. Effect of Pluronic polyols on the viscosity of starch-acrylic latex coating colors*

mately 1750 and comprises approximately 20% of the molecule. The remaining 80% by weight of the molecule consists of hydrophilic chains of oxyethylene groups.

Because of the wide range of molecular weights obtainable in the Pluronic polyol series and because of the two degrees of freedom, properties of the different polyol grades can be plotted as trends across the grid. This is demonstrated in Fig. 2.

By observing these trends, the experimenter can select from the grid those grades having the best balance of properties for his particular application. After only a few laboratory tests, he can narrow this area down to the best polyol or combination of them to meet his needs. For a new application, various polyols across the grid are selected and the experimenter develops his own trends according to his own set of conditions.

## EXPERIMENTAL

### *General*

A standard coating color was used for all the work so that the number of variables could be reduced. A pigment blend of 30% Purecal* calcium carbonate grade 0 and 70% ASP 600 clay was selected as typical. To this pigment blend were added the latices, polyol modifiers, and protective colloids to form the coating color.

The effect of the polyol modifiers was studied in two ways: (1) by determining viscosities of the coating colors and comparing changes with a standard under varied conditions, and (2) by investigating the flow characteristics of the colors at high shear rates.

### *Materials*

The materials used in this work are shown in Table I. They were selected on the basis of applicability and commercial availability.

* Reg. U. S. Patent Office.

### *Equipment*

A Brookfield Model LV viscosimeter was used for the determination of viscosity at low shear rates. Although data were taken at all four spindle speeds available with this instrument, only the data taken at 30 r.p.m. are reported.

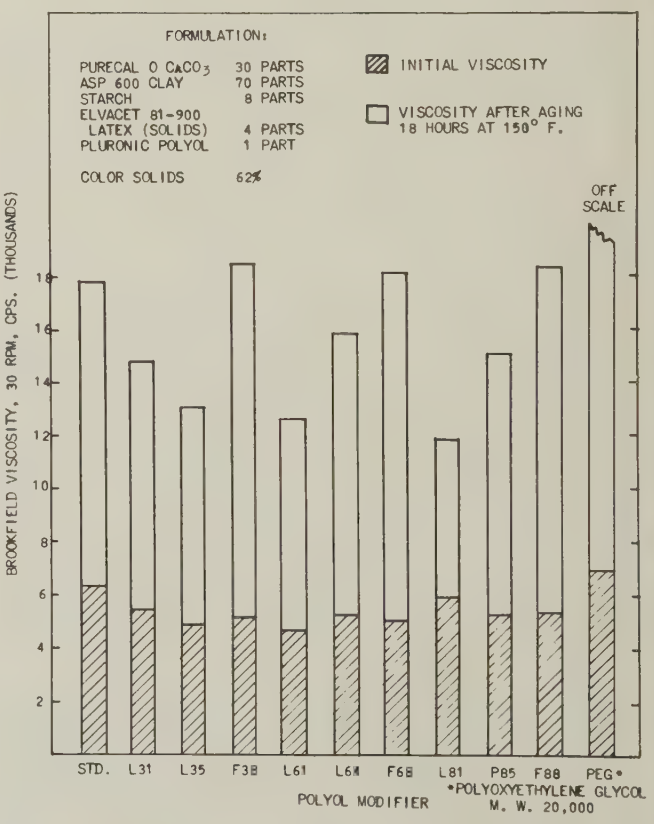
FORMULATION:
PURECAL O CaCO3 30 PARTS
ASP 600 CLAY 70 PARTS
STARCH 8 PARTS
ELVACET 81-900 LATEX (SOLIDS) 4 PARTS
PLURONIC POLYOL 1 PART
COLOR SOLIDS 62%
INITIAL VISCOSITY
VISCOSITY AFTER AGING 18 HOURS AT 150° F.
OFF SCALE
BROOKFIELD VISCOSITY, 30 RPM, CPS. (THOUSANDS)
STD. L31 L35 F38 L61 L64 F68 L81 P85 F88 PEG*
POLYOL MODIFIER
*POLYOXYETHYLENE GLYCOL M. W. 20,000

*Fig. 5. Effect of Pluronic polyols on the viscosity of starch-polyvinyl acetate latex coating colors*

**Table I. Materials Used in Colors**

| *Trade name* | *Manufacturer* | *Type material* |
|---|---|---|
| Pluronic polyols | Wyandotte Chemicals Corp. | Block polymers |
| Stayco M starch | A. E. Staley Mfg. Co. | Moderately oxidized starch |
| Dow 512-L latex | Dow Chemical Co. | Styrene butadiene latex |
| Rhoplex B-15 latex | Rohm & Haas Co. | Acrylic latex |
| Elvacet 81—900 latex | Du Pont Co. | Polyvinyl acetate latex |
| Purecal O calcium carbonate | Wyandotte Chemicals Corp. | Precipitated calcium carbonate |
| ASP 600 clay | Edgar Brothers Div. of M & C | Clay |
| Methocel—4000 | Dow Chemical Co. | Cellulose derivative |
| Calgon | Calgon Co. | Sodium phosphate glass |
| Calgon T | Calgon Co. | Modified sodium phosphate glass |

The Hagan viscosimeter* was used for the determination of flow characteristics at high rates of shear. This instrument was selected as it provided rates of shear more closely approaching those encountered in actual paper coating operations.

The pigment blends were prepared in a Read sigma-blade mixer.

* We wish to thank the Hagan Corp. for the use of the Hagan high shear viscosimeter used in this work.

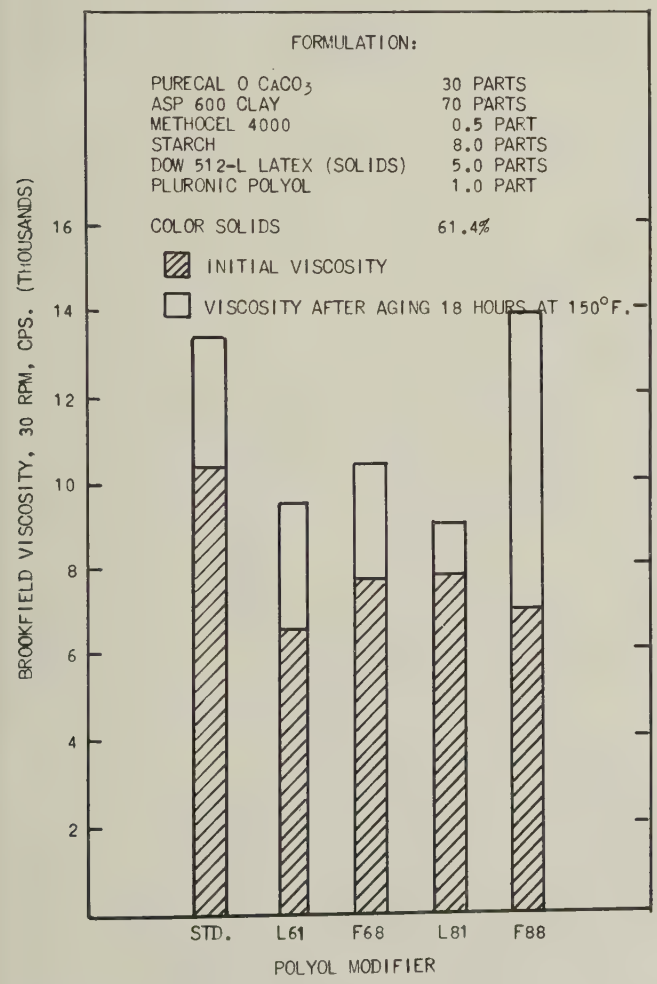


***Fig. 6. Effect of Pluronic polyols on the viscosity of starch-styrene butadiene latex coating color with protective colloid***

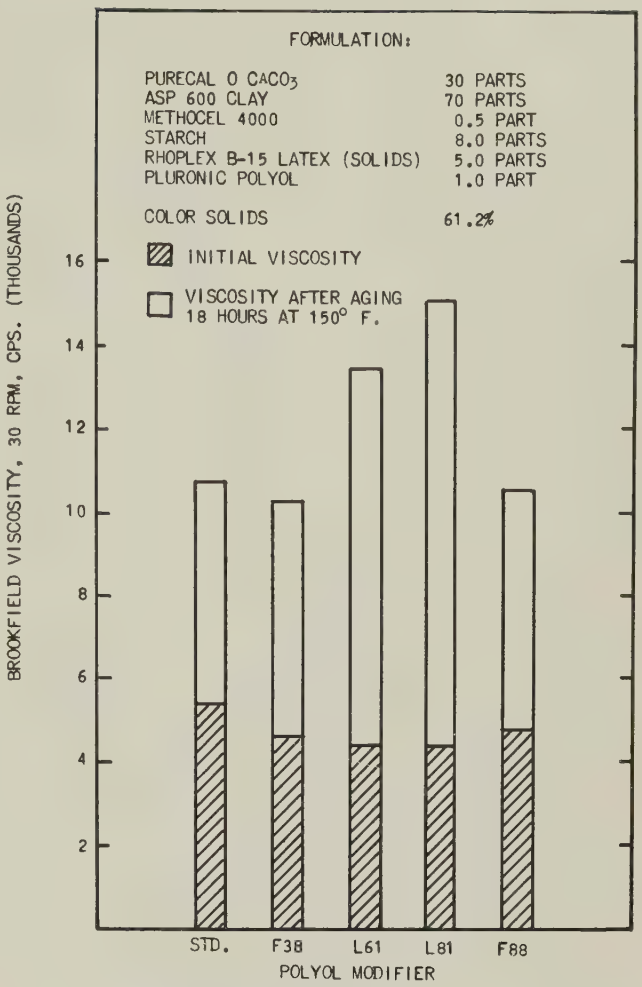


***Fig. 7. Effect of Pluronic polyols on viscosity of starch-acrylic latex coating color with protective colloid***

***Methods***

The major components of the coating colors were prepared separately. The starch solution was made by stirring 300 g. of starch with 700 g. of water in a tared beaker. The dispersion was heated to 195°F. (91°C.) by passing live steam into the starch slurry while mixing with continuous stirring. During the heating operation, the beaker was kept in a water bath. When the temperature of the beaker contents reached 195°F. (91°C.), the steam was shut off and cooking was continued for 15 min. at this temperature. The contents of the beaker were adjusted with water to 1200 g. A transparent starch solution of 25% solids was obtained. The solution was filtered through a 100-mesh screen.

The pigments were prepared as 75% solids dispersion in the heavy duty sigma blade mixer and let down to 72%. The ASP 600 clay was dispersed with 0.5% Calgon and Purecal O calcium carbonate with 1% Calgon T.

Clay dispersion:

| | |
|---|---|
| Water | 1000 g. |
| Calgon | 15 g. |
| Clay | 3000 g. |

Reduced to 72% solids with 166 g. water.

Calcium carbonate dispersion:

| | |
|---|---|
| Water | 1000 g. |
| Calgon T | 30 g. |
| $CaCO_3$ | 3000 g. |

Reduced to 72% solids with 166 g. water.

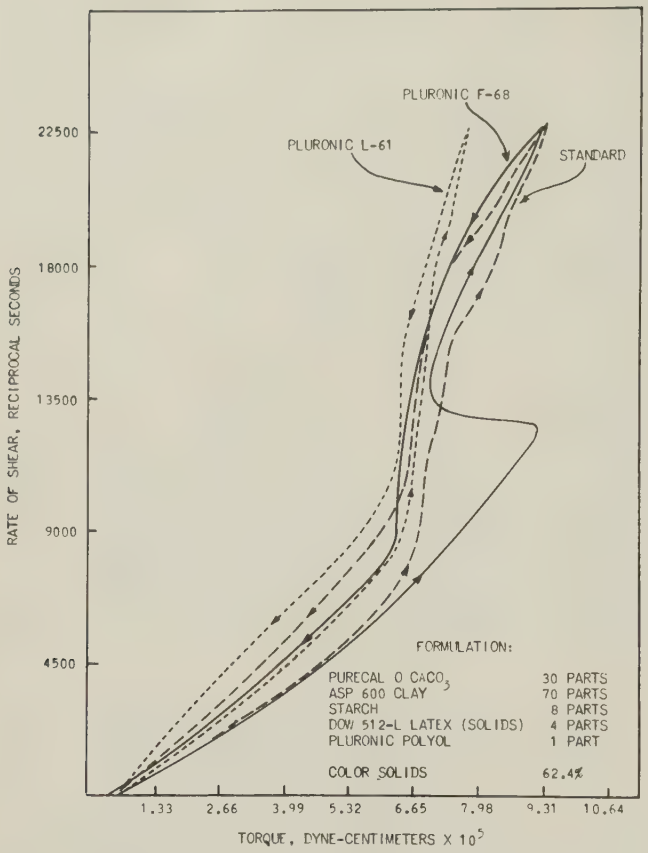


***Fig. 8. Effect of Pluronic polyols on the viscosity of starch-styrene butadiene latex coating colors***

To prepare a color, the clay and calcium carbonate dispersions were mixed and then the starch added. After a thorough mixing, the other ingredients were added. When Methocel was used, it was dispersed with the pigment in the heavy duty mixer.

In order to obtain more comparable data, large batches containing pigments, starch, and protective colloids were prepared. From this master batch, sufficient amounts were used to prepare each color in the series by adding latex and the polyol modifier, which was added as a 25% aqueous solution. In the standards, the polyol portion was replaced by an equal weight of water to maintain the same total solids.

The final colors were prepared from the master batch, additives and water. They were allowed to mix for 5 mins. before being transferred to a container, capped and placed in a constant temperature room at 75°F. Brookfield viscosities were taken after 2 hr., recorded as initial viscosity, and after 24 hr. A portion of the color was aged by a heat treatment, either for 3 hr. at 120°F. or 18 hr. at 150°F. This was done as heat aging has been found important in evaluating the effect of polyols in paper coating colors. The longer treatment at the higher temperature provided a more stringent test.

## RESULTS

### *Viscosity Characteristics*

In the first set of exploratory tests, various Pluronic polyols were added to a starch based color in the amount of 1.0% based on pigment weight. The viscosity showed very little effect caused by the polyol addition. The experiment was repeated using a casein based color and some reduction in viscosity was obtained.

In the next series of tests, a starch-styrene butadiene coating color was tested. The Brookfield viscosities obtained at 30 r.p.m., both initially and after aging at 120°F., are presented in Fig. 3. Except for that treated with polyol F-88, the initial viscosities of the treated colors were from 300–900 cp. lower than the standard. The viscosities of the aged colors, except that treated with Pluronic F-88, were from 2700–3800 cp. lower than the standard. The polyols in the 30 and 60 series were more effective than those in the 80 series; the polyols in the two former series with the smallest hydrophilic units were more effective.

In Fig. 4, data for the starch-acrylic coating colors are presented. With this latex, the coating colors had a lower viscosity than those containing styrene butadiene latex. The polyols were much less effective in reducing the viscosities of these colors. Only three of the polyols caused a reduction in the initial viscosity and only two of them reduced the viscosity of the aged colors. Contrary to the effects found and shown in Fig. 3, the polyols with low hydrophilic ratio caused an increase in viscosity in these colors.

In Fig. 5, data are shown for the starch-polyvinyl acetate colors. The viscosities of these colors are generally higher than those in the other systems. The polyols reduced the initial viscosities as much as 700 cp. (L-61). These colors were subjected to a more severe aging test—18 hr. at 150°F.—and the viscosities of the aged colors were much greater than the initial viscosities.

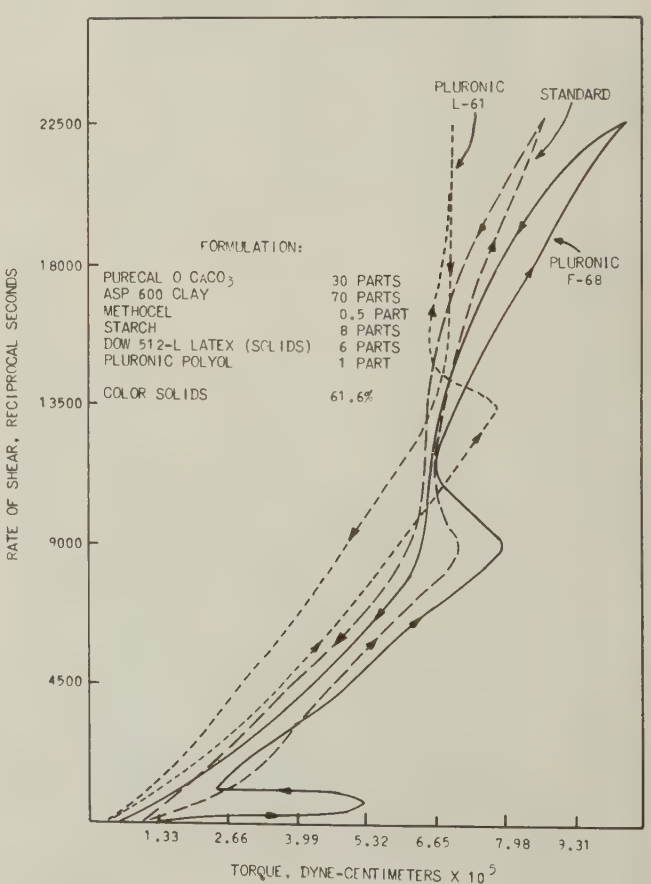


***Fig. 9. Effect of Pluronic polyols on the viscosity of styrene butadiene latex coating colors with protective colloid***

The polyols with lower hydrophilic ratios were most effective in reducing the viscosities of the aged colors. A polyoxyethylene glycol of 20,000 molecular weight was included in these tests to show the effect of a high molecular weight polyoxyethylene glycol compound; it greatly increased the viscosity of the aged sample.

In some of our work, the presence of a protective colloid appeared to be useful in conjunction with polyols for viscosity stabilization. Data showing the effect of a protective colloid, methylcellulose, in a starch-styrene butadiene latex color are presented in Fig. 6. The addition of the methylcellulose causes a large increase in initial viscosity of all the colors but all the polyols tested were effective in reducing the initial viscosity. Those with low hydrophilic units were most effective in reducing the viscosity of the aged colors.

Data for the effect of the protective colloid on a starch-acrylic latex color are shown in Fig. 7. The protective colloid causes a twofold increase in initial viscosity, but all the polyols tested reduced the initial viscosities below the standard. The two polyols with high hydrophilic ratios caused a slight reduction in the viscosities of the aged colors. The polyols with a low hydrophilic ratio gave an increase in viscosity of aged colors in the same manner as in colors without the protective colloid.

***Flow Characteristics at Very High Shear***

Rheograms for a number of colors were obtained using the Hagan viscosimeter. These colors were aged 24 hr., at ambient temperature and mixed by hand just before testing. Some of the rheograms showed break points in the shear range of 10,000–13,000 reciprocal sec., but these effects are not considered in this discussion. The changes in torque at very high shear, above 15,000 reciprocal sec., are particularly interesting in showing the effect of polyols on the flow of the colors. Generally, the polyols with low hydrophilic character appear to decrease the viscous drag of the colors, perhaps by contributing to some type of particle alignment which increases laminar flow. Conversely, the polyols with high hydrophilic character appear to contribute to turbulent flow and these colors show a slight dilatancy.

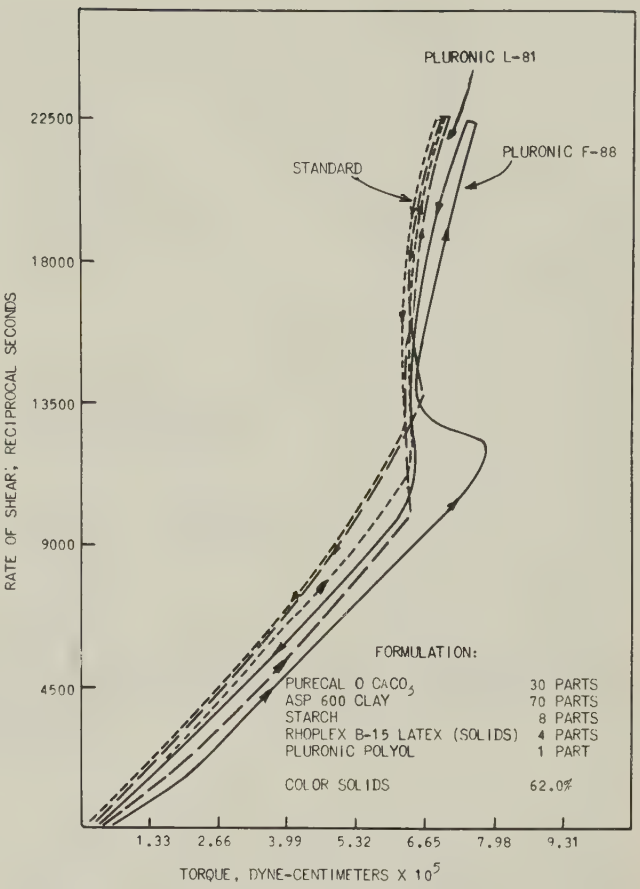


***Fig. 11. Effect of Pluronic polyols on the viscosity of starch acrylic latex coating colors***

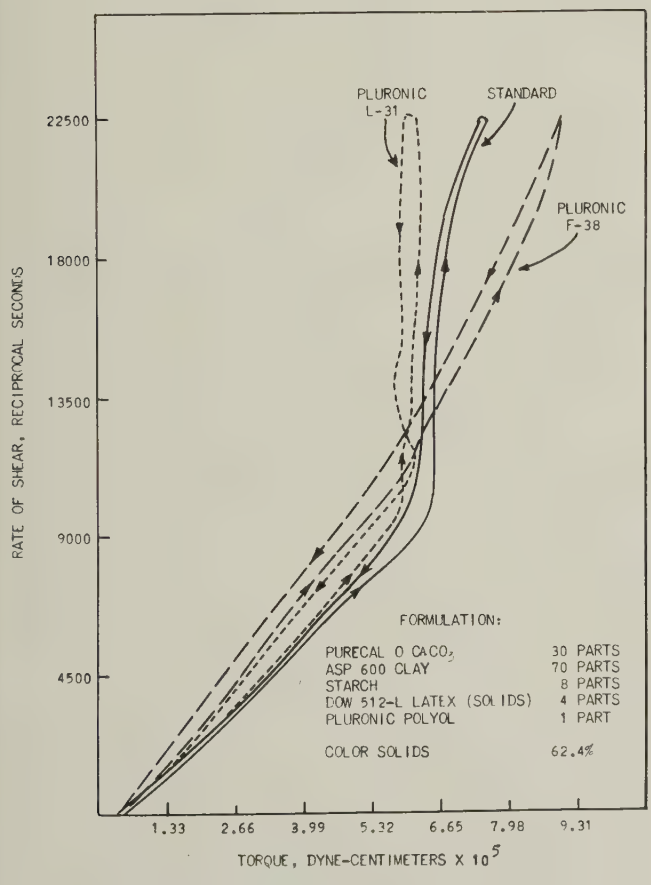


***Fig. 10. Effect of Pluronic polyols on the viscosity of starch-styrene butadiene latex coating colors***

In Fig. 8, rheograms showing the effect of polyols L-61 and F-68 in starch-styrene butadiene colors are presented. It can be seen that polyol L-61 reduces the torque with increasing rate of shear as compared to the standard, particularly at very high shear. Except for the viscosity break at about 12,000 reciprocal sec., the addition of polyol F-68 causes no significant change as compared to the standard.

The same series of tests was repeated except for the inclusion of a protective colloid (0.5 part methylcellulose). The curves are shown in Fig. 9. At very high shear rates, the color containing polyol L-61 shows almost a constant torque with increasing rate of shear. Also at high shear rates the addition of polyol F-68 increases the torque of the color as compared to the standard. Viscosity breaks are found in each of the rheograms.

In Fig. 10, the effect of the 30 series of polyols is presented in starch-styrene butadiene latex colors. Again

at high shear, the color containing polyol L-31 shows a lower torque than the standard while the color containing polyol F-38 increases in torque.

Figure 11 shows the data for the rate of shear versus torque of a starch-acrylic latex coating color. Colors containing polyol L-81 and F-88 differ only slightly from the standard. This is a further indication that the polyols have much less effect on the flow characteristics of colors containing acrylic latex than in colors containing styrene butadiene latex.


### SUMMARY

In both parts of this work, the viscosity and flow characteristics of colors containing polyols have been shown to differ according to the hydrophilic-hydrophobic ratio of the polyol.

Polyols of a low hydrophilic ratio, such as L-31, L-61, and L-81, are more effective in lowering viscosity and contributing to stabilization of starch-styrene butadiene latex and starch-polyvinyl acetate latex colors than polyols with a high hydrophilic ratio.

Polyols of low hydrophilic ratio tend to increase the viscosity of starch-acrylic latex colors, particularly upon aging, contrary to their effect in starch-styrene butadiene latex colors.

Polyols of a low hydrophilic ratio are effective in reducing the viscosity of colors containing a protective colloid although the protective colloid, methylcellulose, increased the viscosity of starch-latex colors.

Polyols with a low hydrophilic ratio appear to promote laminar flow, thus reducing viscous drag at high rates of shear and giving a lower torque.

The work in this paper shows the possibility of utilizing polyoxyalkylene polyols to control the viscosity of coating colors and to improve flow characteristics during high speed coating operations.



Received Jan. 29, 1959. Presented at the Ninth Coating Conference of the Technical Association of the Pulp and Paper Industry, Bedford, Pa., May 14–16, 1958.


# Some of the Factors Affecting the Printing Quality of Newsprint


R. W. PRINCE



**The ANPA Research Institute has studied some of the physical properties of newsprint that are associated with printability as it pertains to printing quality. Some 600 newsprint samples from 54 of the 56 North American newsprint mills were obtained from 54 newspapers over a 12-month period. A sampling procedure was developed which, it is believed, assures that test samples are received equal to, or closely approximating, the condition of the newsprint as used by the publisher. Fifteen physical properties were measured, utilizing equipment and techniques available to the industry. The data so obtained were examined statistically for probable relationship to printing quality. The printability test used for this purpose has been previously described in the literature and involves the use of a proof press under controlled ink and printing pressure. The findings were subjected to a multiple regression analysis in the belief that good printability results from a combination of several paper properties. From this analysis it was concluded that from 50 to 60% of the differences in printability are accounted for by differences in smoothness, hardness, and brightness. The remaining 40 to 50% are attributed to factors other than smoothness, hardness, and brightness. For example, of the total variance in printability on the wire side, mathematical analysis indicates that 32% is due to the effects of smoothness alone, 10% to the hardness alone, 3% to brightness alone, and 13% to a combination of smoothness, hardness, and brightness varying together. Basis weight, tearing strength, and sheet density play a lesser role. Of the remaining properties, opacity, porosity, ink absorption, and sheet caliper affect printability to a minor degree. "Scatter diagrams" have been prepared, including those in which proof press printability has been plotted against each of the measured physical characteristics.**


A NEWSPRINT quality measurement program has been functioning at the ANPA Research Institute Laboratory since November, 1957. Prior to this, The Institute of Paper Chemisty, under contract to the ANPA, had made studies of ink receptivity of newsprint (*1–5*) and instruments pertinent to the evaluation of newsprint (*6*, *7*). While considerable information of value was obtained from the work of The Institute of Paper Chemistry, the studies did not proceed to a point where it was possible to correlate the physical properties of the newsprint with the quality ranking of the printed sheet which had been obtained by subjective evaluation (*8*).

If newspapers are to be printed better, it would seem desirable to find the particular physical properties of newsprint which contribute to the ultimate printing quality of the sheet and their relative importance in printing qualtiy. In addition to the variables encountered in papermaking, it is recognized that there are many variables beyond the influence of the paper itself. Press equipment, ink, press presonnel, and variables in the many components involved prior to the ink-paper relationship are potential contributors to the quality of the printed sheet. However, it is known that different newsprints, when run on the same presses with the same inks and pressroom personnel and with the same process variables involved, can also exhibit visual differences in printing quality. Therefore, it is of considerable importance to study the effect of paper properties on the printing ability of the newsprint.

In order to do this, the ANPA Research Institute set up newsprint testing facilities in a laboratory maintained at 72°F. and 45% R. H. These conditions of temperature and humidity were chosen instead of the standard TAPPI conditions of 73°F. and 50% R.H. because the humidity of newsprint, as used in the pressroom, is probably closer to the ambient condition represented by 45% R.H. at 72°F.


R. W. PRINCE, ANPA Research Institute, Inc., Easton, Pa.

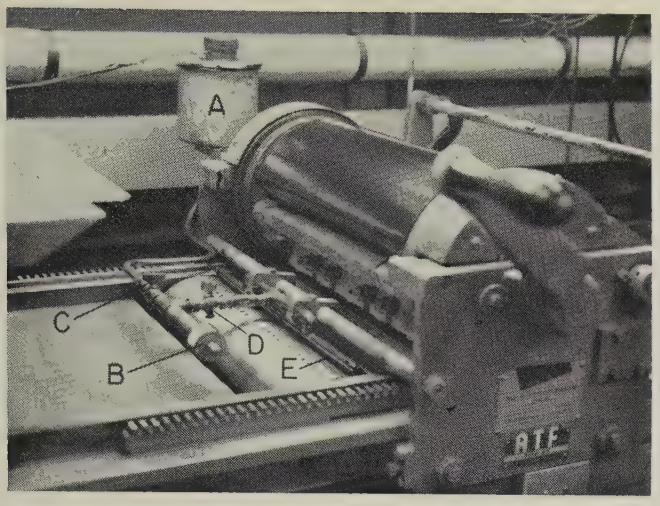


*Fig. A*

Instruments to perform the desired tests were selected and checked before purchase as to their ability to perform within the desired accuracy of the measurement.

No tests were included which depend on subjective observation for determination of the measurement. There are some paper properties, however, which normally are evaluated only by visual observation. To investigate these properties, such as formation and ink absorption, instrumentation has been employed which is not now accepted as a standard test. However, instruments selected are readily available and the tests reproducible by any laboratory desiring to do so.

Every instrument used for the tests is recalibrated weekly and preventive maintenance performed. Automatic, clock-controlled switching provides a 2-hr. warm-up of electronic instruments prior to the arrival of the technicians each morning.

## SAMPLING

Approximately 600 newsprint samples from 54 of the 56 North American newsprint mills were obtained from 54 newspapers over a 12-month period. A procedure for packaging newsprint samples was developed so as to ensure that the samples would not be affected by atmospheric moisture while in transit from the pressroom to the laboratory. Each participating newspaper is supplied with a kit containing all the materials, tools, and instructions to collect and adequately package 12 samples of newsprint. The instructions and kit description are available from ANPA Research Institute to anyone interested. The sample is removed from the roll at a core diameter of about 8 in. Using this inside section assures a sample close to the "in roll" condition and provides the required size sheets. Each sample comprises 30 sheets (30 turns from the 8-in. diam. roll).

## TESTS AND PROCEDURES

The sealed samples of newsprint are stored without opening in the laboratory temperature and humidity control room until time for testing. When the package is opened, the sheets are handled with rubber gloves and placed in a shallow, moistureproof box as an attempt to preserve the original condition of the newsprint. Basis weight and moisture tests are performed within a few seconds on sheets pulled from the center of the stack. All tests are performed on sheets taken from the center of the stack in the moistureproof box.

The following tests have been performed on the samples:

1. Moisture.
2. Basis weight.
3. Caliper.
4. Formation.
5. Smoothness (felt and wire side).
6. Printing hardness (felt and wire side).
7. Porosity.
8. Printability (felt and wire side).
9. Tensile strength (machine and cross-machine direction).
10. Stretch (machine and cross-machine direction).
11. Opacity.
12. Show-through.
13. Brightness.
14. Apparent density.
15. Tear (machine and cross-machine direction).
16. Ink absorption rate (felt and wire side).
17. Ink transfer (felt and wire side).

Appendix I lists the instruments used for these tests and the TAPPI test upon which the measurement is based.

The data from each test on each sample are recorded on an IBM card, enabling individual sets of readings to be separated quickly and regrouped in any manner, using ordinary card sorting equipment.

## PRINTABILITY TEST

Each sample of newsprint is printed on a Vandercook no. 4 proof press under carefully controlled settings. The amount of ink on the plate is held at 2 g. per sq. m. ±0.03 g. and the nip load set at 60 lb. per linear in. A reflectance measurement of the printed samples constitutes the printability test to which variations in measured physical properties are compared. The procedure and measurements are those described by Larocque, Axelrod, and Clark (*9*), with the modifications noted in Appendix II. Since this test depends upon the ability of the sheet to reproduce the pattern from a solid printing plate, it is apparent that printability, as herein used, is defined in terms of proof press printing quality.

## METHOD OF ANALYSIS

The first step in analyzing the data was to select the physical properties which, in the judgment of the Re-

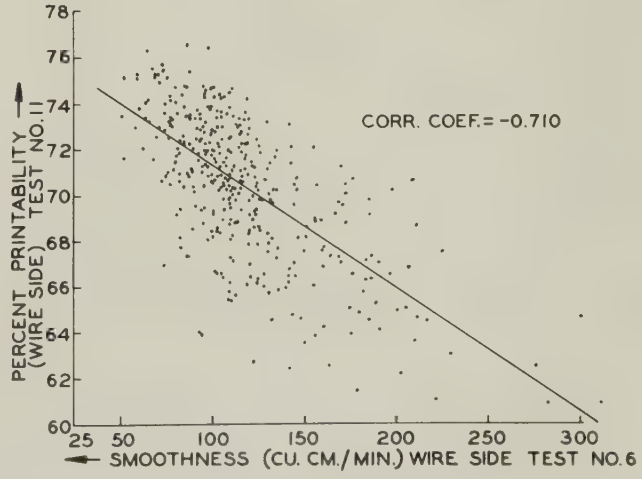


*Fig. 1*

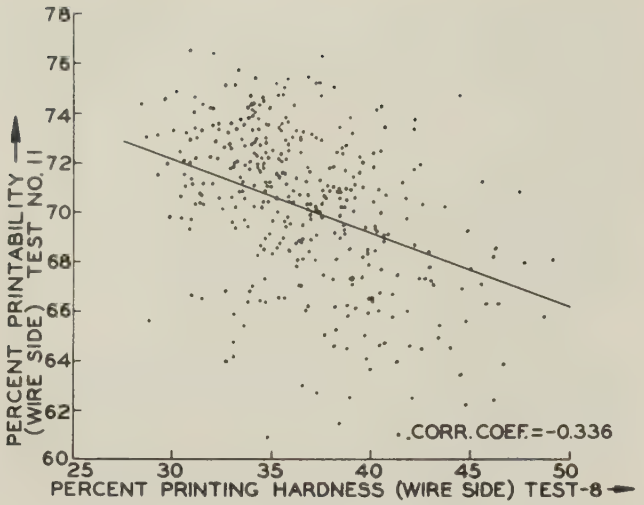


*Fig. 2*

search Institute, might influence the print quality characteristics of the newsprint. Initially, five quality characteristics were selected for study. These were (1) smoothness, (2) hardness, (3) brightness, (4) porosity, and (5) opacity.

The printability values were plotted against the corresponding test values for each of these five tests to obtain "scatter diagrams" as shown in the figures (Figs. 1, 2, 3, 6, 7). Each of these plots was examined visually to see if there appeared to be any correlation with the printability.

When the object of an investigation is the output of some manufacturing process and the investigating group is divorced from the manufacturing unit, a designed experiment, calling for changes in the condition of manufacture, is impossible. Under these conditions, variations in the factors affecting the result under study cannot be controlled by the laboratory but must be taken as they come. In this case, the effects of the various factors can, nevertheless, be measured and separated by statistical analysis. In addition, the statistical approach, because of the method of sampling

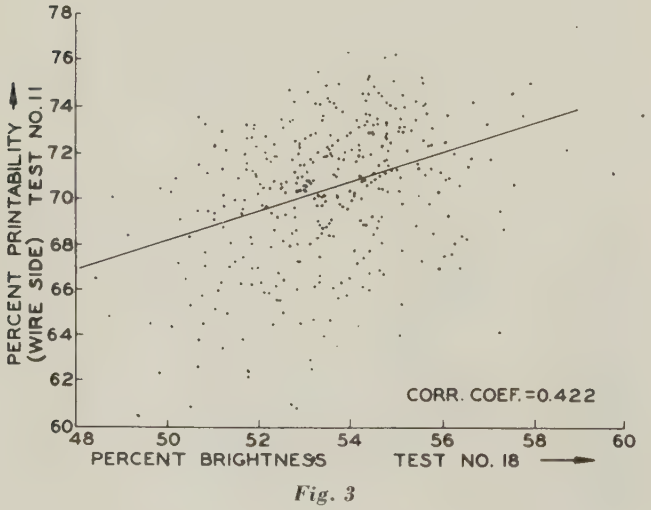


*Fig. 3*

employed, has yielded considerable information as to the magnitude of the variations which are to be found in present-day commercial newsprint paper. The ANPA Research Institute has taken the newsprint as it was received by newspapers from the mills. No samples were specially selected, and the number of samples is believed to be large enough so as to permit the use of statistical analysis.

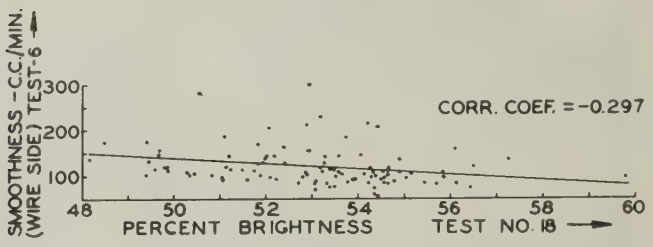


*Fig. 4*

To know that a measure of correlation exists between some of the measured physical properties and printability is not sufficient for the purposes of the investigation. It was desired to find out not only what physical characteristics of the paper influence the printability of newsprint but also the degree of influence of each paper property. To accomplish this, a multiple regression equation was fitted by the method of least squares to the five properties listed above (see Appendix III). Correlation coefficients were also computed for certain combinations of the 17 tests previously enumerated.

The coefficient of correlation measures the degree of association between two variables. A coefficient of 1.0 is rarely obtained since it would indicate that one property is wholly dependent upon another, and all points would lie on the line with no scatter. Values approaching this quality, e.g., from 0.7 to 0.9, indicate that one property is strongly influenced by another, although not entirely dependent upon it. Of the lower values, e.g., 0.2 and less, there is very little dependence between the two properties.

We have listed in Table I the correlations which were observed between proof press printability and some of the physical properties which were measured with a view to ascertaining their possible influence upon printability. In Table II are listed some additional relationships which were observed between various properties. Some of these correlations may be of interest both to the user and the manufacturer of newsprint paper.

The square of the coefficient of correlation can be viewed as measuring the relative amount of variation in the dependent variable that is "explained" by the

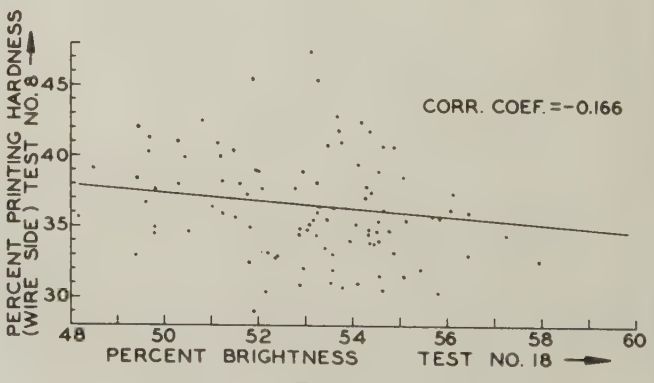


*Fig. 5*

**Table I. Correlation of Printability and Various Physical Properties**

| *Property* | *Correlation coefficient* |
|---|---|
| Wire Side | |
| Ink transfer | 0.92 |
| Smoothness | 0.71 |
| Brightness | 0.42 |
| Tear (across machine) | −0.41 |
| Basis weight | 0.34 |
| Hardness | −0.34 |
| Apparent density | 0.29 |
| Opacity | 0.17 |
| Porosity | −0.17 |
| Ink absorption | 0.14 |
| Caliper | −0.11 |
| Tensile | −0.05 |
| Show-through | 0.04 |
| Stretch (across machine) | 0.0004 |
| Felt Side | |
| Ink transfer | 0.90 |
| Smoothness | 0.65 |
| Brightness | 0.43 |
| Tear (across machine) | −0.35 |
| Basis weight | 0.28 |
| Tear (machine) | −0.25 |
| Apparent density | 0.23 |
| Opacity | 0.21 |
| Hardness | −0.17 |
| Porosity | −0.15 |
| Ink absorption | 0.14 |
| Show-through | 0.07 |
| Caliper | −0.06 |

independent variable. Thus, it is seen that if the correlation coefficient is 0.2, the independent variable may only affect the dependent variable by $(0.2)^2$ or 4%.

When more than two independent variables are considered to be involved, the multiple regression analysis will determine the effect of each of the variables and, also, the effect of all of the independent variables working together.

## CONCLUSIONS

From the multiple regression analyses that have been run to date, it has been concluded that smoothness, hardness, and brightness contribute significantly to the printability of the newsprint, as determined by the Larocque printability test. Specifically, for the *wire side* of the newsprint, it has been established that 58% of the differences in the printability can be accounted for by differences in smoothness, hardness, and brightness (see Figs. 1, 2, and 3). Further mathematical analysis indicates that of the total variance in printability, 32% can be attributed to the effects of smoothness alone, 10% to the effects of hardness alone, 3% to the effects of brightness alone. About 13% cannot be separated because smoothness, hardness, and brightness tend, to some extent, to vary together.

Analysis of the *felt side* of the newsprint leads us to conclude that 51% of the variation in printability is accounted for by the combined effects of smoothness, hardness, and brightness and that of the total variance in printability, 27% is due to the effects of smoothness alone, 7% to the effects of hardness alone, 7% to the effects of brigtness alone, and 10% due to the effects

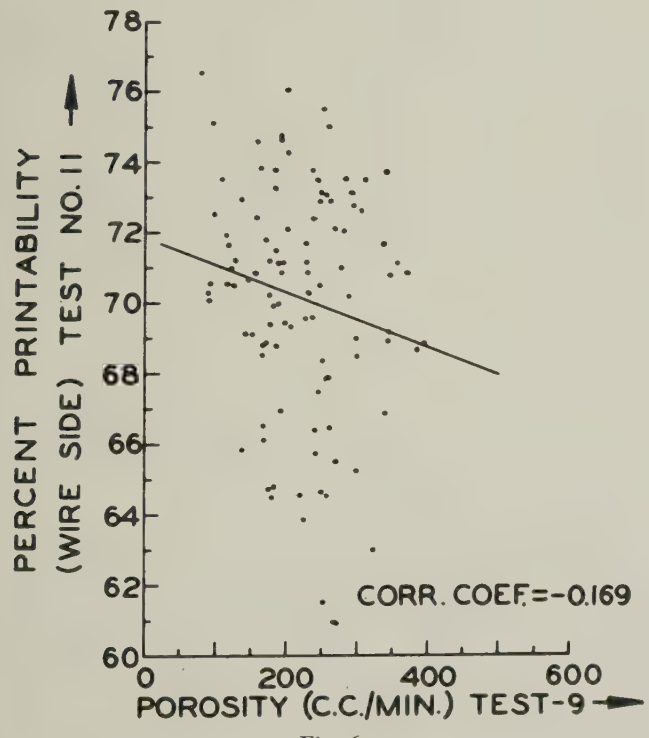


*Fig. 6*

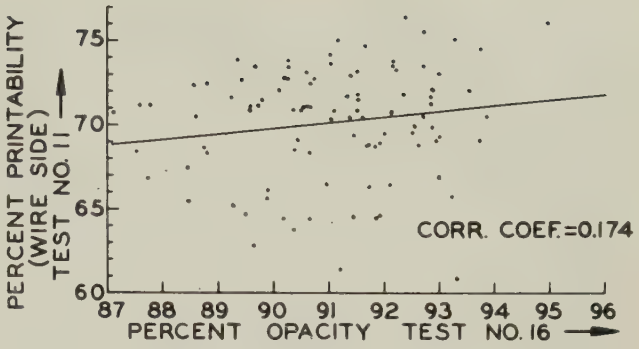


*Fig. 7*

**Table II. Intercorrelation of Other Physical Properties**

| *Properties* | *Correlation coefficient* |
|---|---|
| Printability ws and fs | 0.84 |
| Smoothness ws and fs | 0.78 |
| Hardness ws and fs | 0.76 |
| Show-through and caliper | 0.76 |
| Ink transfer and smoothness | 0.74 |
| Show-through and opacity | 0.72 |
| Show-through and basis weight | 0.72 |
| Tensile MD and stretch MD | 0.54 |
| Moisture and basis weight | 0.53 |
| Ink absorption and porosity | 0.46 |
| Tear CD and stretch MD | 0.46 |
| Ink transfer and hardness | −0.45 |
| Tensile MD and porosity | −0.38 |
| Smoothness ws and porosity | 0.38 |
| Opacity and caliper | 0.35 |
| Hardness ws and caliper | −0.34 |
| Opacity and porosity | −0.32 |
| Tensile and basis weight | 0.31 |
| Tear CM and tensile MD | 0.31 |
| Smoothness ws and brightness | −0.30 |
| Tear CM and basis weight | 0.29 |
| Ink transfer and apparent density | 0.25 |
| Show-through and brightness | 0.24 |
| Opacity and brightness | −0.20 |
| Ink absorption ws and caliper | 0.19 |
| Ink transfer ws and porosity | −0.18 |
| Show-through and ws smoothness | 0.18 |
| Hardness ws and brightness | −0.17 |
| Smoothness ws and opacity | −0.13 |
| Ink absorption ws and basis weight | −0.11 |
| Smoothness ws and hardness ws | 0.10 |
| Porosity and hardness ws | 0.10 |
| Opacity and hardness ws | 0.07 |
| Tear CD and caliper | 0.05 |

of smoothness, brightness, and hardness varying together.

The observed correlation of brightness with proof press printability is surprising and may be due to a

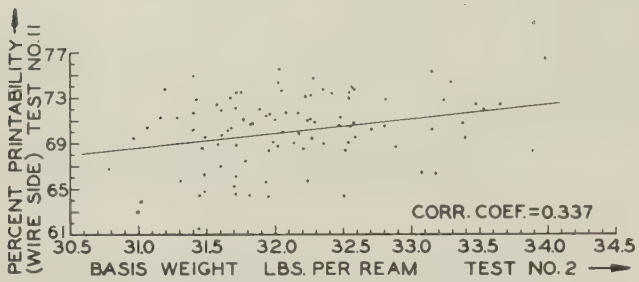


*Fig. 8*

greater degree of brightness among the softer (and better printing) sheets. The brightness measurement consists of ten readings on the felt side of the sheet, as is usual. Therefore, the correlation of brightness and proof press printability of the felt side is slightly better than the correlation of brightness and printability of the wire side. Reflectance measurements were made on printed and unprinted areas of both sides of the sheet in obtaining the Larocque printability values. Scatter diagrams do indicate correlation (0.3) of brightness with wire side smoothness (Fig. 4). There appears to be less correlation (0.17) between brightness and wire side hardness from inspection of the scatter diagram (see Fig. 5).

The effects on printability of variation in porosity and opacity are currently being studied. Preliminary analysis suggests that these two, together, will probably account for another 5% of the variations in newsprint quality (see Figs. 6 and 7).

One interesting scatter diagram (Fig. 8) is that for basis weight versus Larocque printability. The degree of correlation (0.34) indicates that basis weight variations may affect proof press printability almost 10%.

When correlation is relatively strong, such as between smoothness and printability (Fig. 1, correlation coefficient of 0.71), the influence is easily recognizable visually. However, visual inspection of the scatter diagrams can be very misleading; and it is recommended that the correlation coefficients be noted before judgment is passed as to the significance of any of the relationships. In most cases, the correlation coefficients listed in Tables I and II have been determined from consideration of 100 randomly selected points.

Recent tests on a commercial size newspaper press in our laboratory have shown that a significant correlation exists between the printing obtainable on a newspaper press and the proof press test of printing quality. This phase of the present investigation is being continued. The results to date are sufficient, however, to indicate that the conclusions based upon proof press printing do actually have bearing upon the printing quality obtained under practical production printing conditions. We can, then, conclude that the proof press printability test does indicate the printing quality of a given sheet of newsprint. Furthermore, the Larocque printability test is one which can be carried out at any newsprint mill to check the printing quality of their paper. By using the modifications of the inking system outlined in Appendix II, any mill can perform the test quickly and easily so as to determine the printing quality of their newsprint from day to day or even, if need be, from hour to hour. This, in turn, could lead to the development of a better sheet through the control of the process variables which appear to have a significant effect on the resulting printing quality of the newsprint.

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## APPENDIX I

### Instruments and Procedures Used for Newsprint Testing

| *Test & physical property measured* | *Equipment used for making test* | *Test procedure* | *Number of readings made per sample* |
|---|---|---|---|
| Moisture content (based on TAPPI Standard T 412 m-53) | Cenco moisture balance no. 26675 & 4-in. circular die punch | Sheet is taken from middle of 30-sheet pile in moisture safe and folded to 16 layers. A 4-in. circle is cut out with the punch and placed in the moisture balance. It is then dehydrated to moisture-free dryness under a heat lamp directed on the balance pan. The instrument is then re-balanced. The difference in the scale readings on the moisture balance is used to calculate the per cent moisture in the sample. | Three separate runs per sample |
| Basis weight (based on TAPPI Standard T 410 m-45) | Thwing-Albert no. 63-23 basis weight scale, 18 × 24-in. brass template | Ten sheets taken from the middle of the moisture safe are folded once side to side to insure getting samples from both halves of roll width. Twenty pieces are cut out to within 0.25% of 18 × 24 in. using a heavy brass template. Two pieces are weighed at one time on the scale, which reads directly in basis weight per ream. | Ten weighings per sample (correct to within 0.1 lb.) |

| | | | |
|---|---|---|---|
| Caliper (based on TAPPI Standard T 411 m-45) | Testing Machines, Inc., motorized caliper, model no. 549 (dial indicator) | Sheet is placed between plane faces of the micrometer which are under a pressure of 7 to 9 p.s.i. The thickness is read directly from a dial indicator. | One reading made randomly on each of twenty sheets. Average every two sheets for a total of ten readings |
| Formation | Thwing-Albert formation tester, model no. 217 | A formation standard developed at the laboratory is used to calibrate the tester at 100 formation units. A circular sample of newsprint after nulling the tester with the standard is tested by scanning with source and phototube mechanism, giving a comparison ratio which is read directly from a meter on the tester. | Five sheets scanned on wire side and five more on felt side |
| Tensile strength (based on TAPPI Standard T 404 m-50) | Schopper type tensile tester (motorized) and Thwing-Albert IDC precision cutter | A sample exactly 1 in. wide and 7 in. long is cut out on the precision cutter and placed in the jaws of the pendulum-type tester. A motor drives a weight up a plane which in turn applies a steady tension to the sample until the latter breaks. The highest point reached by the weight is indicated on a scale calibrated directly in pounds per inch. | Ten strips cut roll across (machine direction) and 10 cut with the roll (machine) |
| Stretch | Schopper type tensile tester (motorized) and Thwing-Albert IDC precision cutter | This test is actually a part of the tensile strength test in that the amount the jaws holding each end of the paper sample move apart is indicated simultaneously on another dial calibrated in per cent elongation. | Ten strips cut roll across (machine direction) and 10 cut with the roll (machine) |
| Opacity (based on TAPPI Standard T 425 m-44) | Bausch & Lomb opacimeter | The opacimeter is calibrated by using TAPPI 89% white standard made of magnesium carbonate. The sample is then placed in the light beam and standardized to 10 (full scale) with the white background. The reflectance is then read directly with the black background. This reading × 100 = opacity. | Ten sheets |
| Show-through | Bausch & Lomb opacimeter | The opacimeter is set to zero reading on the scale with the black body and 10 (full scale) on the scale with the white body. With a printed sample in the instrument (printed side facing the operator), the ratio of the light reflected from the unprinted part of the paper to the light reflected from the printed part is taken. The resulting number, multiplied by 100, is recorded as the show through of the paper. | Ten readings: five on felt side, five on wire side |
| Smoothness | Bendtsen smoothness & porosity tester | Use 150 water g. weight on machine for smoothness test. The head is placed on the sample and the quantity of air slipping out around the edges is read directly from the calibrated manometer tube. | Ten readings, each on the wire and felt sides |
| Printing hardness | Bendtsen smoothness & porosity tester | The same procedure as above is used except that a 5 kg. per sq. cm. weight is added to the head, forcing it into the paper. A ratio is calculated using the smoothness figure along with this reading. | Ten readings, each on the wire and felt sides. Ratio = hardness/smoothness × 100 |
| Porosity | Bendtsen smoothness & porosity tester (special jig & head) | Use 75 water g. weight on machine for porosity test. A special jig is used to clamp the paper in the porosity head insuring no leakage around the edges. Porosity is measured by the quantity of air forced through the newsprint. | Ten readings: five on felt side, five on wire side |
| Brightness | Hunter reflectometer | The amount of reflection from a known standard is first used to calibrate the reflectometer after which the sample is measured, the value read being a comparison of the two. | Each of ten sheets is measured in the middle |
| Apparent Density | (None used) | Calculated ratio of average of 10 basis weight readings to average of 10 caliper readings. | One calculation per sample, basis weight/caliper |
| Printability | Larocque printability test | A precision 6 × 7-in. plate is inked with a controlled quantity of ink and printed on a sample of newsprint using a printing pressure of 60 lb. per linear in. The resulting print is then expressed numerically through the use of the Hunter reflectometer by comparing printed and unprinted reflectance. | Five samples each on the wire and on the felt sides |
| Ink absorption | Vanceometer | The black glass is cleaned thoroughly and raised into position. The meter scale is then set to read 100, and the plate lowered. A steel roller is positioned under a buret containing news ink. The sample newsprint is clamped to the glass plate. Two drops of ink are metered onto the steel roller and the roller released to pass down an inclined plane and over the newsprint. The plate with the newsprint is then raised to the reading position and the meter reading recorded. Twenty seconds later the meter reading is recorded again. The difference in the two readings divided by the initial reading is recorded as per cent absorption. | Twenty readings: ten on felt side, ten on wire side |
| Tear (based on TAPPI Standard T 414 m-49) | Elmendorf tear tester precision cutter | Samples are cut 63 mm. × 3 in. Each sample consists of 16 sheets cut to dimension simultaneously. The instrument is leveled and zeroed and the sample of 16 sheets placed between jaws of the paper clamp. A knife blade is provided to nick the sample after which the pendulum is allowed to swing once in each direction. The reading in grams is recorded. | Ten samples tested in machine direction and ten samples tested in cross-machine direction |

APPENDIX I. Instruments and Procedures Used for Newsprint Testing (*Continued*)

| *Test & physical property measured* | *Equipment used for making test* | *Test procedure* | *Number of readings made per sample* |
|---|---|---|---|
| Ink transfer | Larocque printability test, analytical balance | The magnesium plate is inked and weighed. After proof for Larocque test is pulled, plate is weighed again to nearest 0.0001 g. before cleaning and the difference in weight of the ink to the weight of the ink on plate before proofing is recorded as per cent transfer. | Ten readings: five on felt side, five on wire side |

## APPENDIX II—LAROCQUE TEST MODIFICATIONS

Performing the Larocque printability test can be simplified and speeded up by employing means to control closely the amount of ink supplied to the printing plate. ANPA Research Institute has designed an ink-control system after discussion of a system employed at The Institute of Paper Chemistry.* Referring to Fig. A, this ink-metering system consists of

A. An ink reservoir fitted with an electrically driven agitator rotating at 5 r.p.m.
B. A piston fitted with a lead screw to which is attached a dial marked 0 to 50 in one-unit increments.
C. A feed pipe from the reservoir to the piston equipped with a cutoff valve in the feed line.
D. A feed pipe from piston to ink lay-down tube with a cutoff valve in the feed line.
E. An ink lay-down tube with 0.015-in. holes drilled on $^1/_2$-in. centers for the length of the tube.

The ink reservoir is filled with news ink which has been filtered through a 140-mesh screen to prevent solids from clogging the supply holes in the lay-down tube. The weight of the ink on a 6 × 7-in. magnesium plate is kept between 0.0520 and 0.0562 g. The ink-control system permits control of the amount of ink to ±0.0008 g.

Detail drawings for duplicating this system of ink control on a Vandercook no. 4 proof press are available from the ANPA Research Institute Laboratory.

## APPENDIX III—STATISTICAL SUMMARY

Variables

$X_1$ = mean of 5 measurements of printability of sample unit.
$X_2$ = mean of 10 measurements of roughness of sample unit.

*smoothness* equals $(-X_2)$

$X_3$ = mean of 10 measurements of hardness of sample unit.
$X_4$ = mean of 10 measurements of brightness of sample unit.

For the felt side of the samples, the regression equation is derived from the following:

*Means*[1]:

$\bar{X}_1 = 69.95,\ \bar{X}_2 = 93.20,\ \bar{X}_3 = 37.24,\ \bar{X}_4 = 53.57$

*Standard Deviations*[2]:

$\sigma_1 = 2.881,\ \sigma_2 = 22.44,\ \sigma_3 = 3.142,\ \sigma_4 = 1.653$

*Coefficients of Correlation*[3]:

$r_{12} = -0.5730,\ r_{13} = -0.3566,\ r_{14} = 0.4380$
$r_{23} = 0.0161,\ -r_{24} = 0.1775$
$r_{34} = -0.3115$

*Coefficient of Multiple Correlation*[4]:

$R_{1.234}^2 = 0.5091,\ R_{1.234} = 0.7135$

*Regression Equation*[5] for Predicting $X_1$ from $X_2$, $X_3$, and $X_4$, with the standard errors (= standard deviation of sampling error) of the coefficients[6]

$$X_{1r} = 60.83 - 0.06705X_2 - 0.2444X_3 + 0.4568X_4$$
$$(\pm 0.007) \quad (\pm 0.053) \quad (\pm 0.103)$$

1. $\bar{X} = \Sigma X/N$.
2. $\sigma = \sqrt{\Sigma(X - \bar{X})^2/N}$.
3. $r_{12} = \Sigma(X_1 - \bar{X}_1)(X_2 - \bar{X}_2)/N\sigma_1\sigma_2$. We can interpret $r_{12}^2$ as the percentage of the variation in $X_1$ that is accounted for by $X_2$.
4. $R_{1.234}^2$ is the percentage of the variation in $X_1$ that is accounted for by $X_2$, $X_3$, and $X_4$ in combination. If $X_2$, $X_3$, and $X_4$ were uncorrelated, we would have $R_{1.234}^2 = r_{12}^2 + r_{13}^2 + r_{14}^2$. Actually, $R_{1.234}^2$ (= 0.51) is less than $r_{12}^2 + r_{13}^2 + r_{14}^2$ (= 0.65) since $r_{23}$, $r_{24}$, and $r_{34}$ are not zero.
5. This equation is derived by the method of "least squares," i.e., the sum of the squares of the deviations of the actual $X_1$ values from those given by the equation $X_{1r}$, for the 164 sets of values to which the equation was fitted, is less than that for any other linear function of $X_2$, $X_3$, and $X_4$ that could be fitted to the data.
6. Reasonable limits for the regression coefficients for the *universe* of tests that might have been made are given by the sample coefficients ± twice their standard errors.

*Standardized Regression Coefficients*[7]: $\beta_{12.34} = -0.5222,\ \beta_{13.24} = -0.2665,\ \beta_{14.25} = 0.2621.$

Analysis of Contributions of $X_2$, $X_3$, and $X_4$ to Variation in $X_1$

| | |
|---|---|
| $\beta_{12.34}^2 = 0.2727$ | − % of variation in $X_1$ attributed directly to effects of $X_2$ |
| $\beta_{13\ 24}^2 = 0.0710$ | − % of variation in $X_1$ attributed directly to effects of $X_3$ |
| $\beta_{14.23}^2 = 0.0687$ | − % of variation in $X_1$ attributed directly to effects of $X_4$ |
| $2\beta_{12.34}\beta_{13.24}r_{23} = 0.0045$ | − % of variation in $X_1$ attributed to combined effects of $X_2$ and $X_3$ |
| $2\beta_{12.34}\beta_{14.23}r_{24} = 0.0485$ | − % of variation in $X_1$ attributed to combined effects of $X_2$ and $X_4$ |
| $2\beta_{13.23}\beta_{14.23}r_{34} = 0.0435$ | − % of variation in $X_1$ attributed to combined effects of $X_3$ and $X_4$ |
| $R_{1.234}^2 = 0.5089$* | − % of variation in $X_1$ attributed to combined effects of $X_2$, $X_3$, and $X_4$. |

For the wire side of the samples, the regression equation becomes

$$X_{1r} = 68.7852 + 0.05081X_2 - 0.25683X_3 + 0.30120X_4$$

and an analysis of the contributions of $X_2$, $X_3$, and $X_4$ to variations in $X_1$ is

$$\beta_{12.34}^2 = 0.3150 \doteqdot 31.5\%$$
$$\beta_{13\ 24}^2 = 0.0995 \doteqdot 10.0\%$$
$$\beta_{14.23}^2 = 0.0250 \doteqdot 2.5\%$$
$$2\beta_{12.34}\beta_{13.24}r_{23} = 0.0724 \doteqdot 7.2\%$$
$$2\beta_{12.34}\beta_{14.23}r_{24} = 0.0339 \doteqdot 3.4\%$$
$$2\beta_{13.23}\beta_{14.23}r_{34} = 0.0343 \doteqdot 3.4\%$$

The total effect of $X_2$, $X_3$, and $X_4$ or

$$R_{1.234}^2 = 0.5801 \doteqdot 58\%$$

7. $\beta_{12.34} = b_{12.34}\frac{\sigma_2}{\sigma_1}$, e.g., $\beta_{12.34} = \frac{-0.06705(22.44)}{2.881} = -0.5222$; etc.

* Wink, W. A., "An Ink Applicator for Supplying Ink to the Distribution Systems of Proof Presses and Other Laboratory Printing Devices," *Tappi* 41, No. 12: 796–800 (December, 1958).

* Difference between this number and the 0.5091 given above is due to rounding off of decimals.

# ASSOCIATION NEWS AND EVENTS

## *National Conferences*

*Tenth Coating Conference*, Statler Hotel, Boston, Mass., May 25–27, 1959.

*Tenth Testing Conference*, Multnomah Hotel, Portland, Ore., Aug. 17–21, 1959.

*Fundamental Research-Wet Strength Conference*, I.P.C., Appleton, Wis., Sept. 9–11, 1959.

*Ninth Corrugated Containers Conference*, Jung Hotel, New Orleans, La., Sept. 15–17, 1959.

*Fourteenth Paper-Plastics Conference*, Edgewater Beach Hotel, Chicago, Ill., Sept. 21–23, 1959.

*Fourteenth Engineering Conference*, Penn-Sheraton Hotel, Pittsburgh, Pa., Oct. 12–15, 1959.

*Thirteenth Alkaline Pulping Conference*, Robert Meyer Hotel, Jacksonville, Fla., Nov. 4–6, 1959.

## *Local Section Meetings*

*Maine-New Hampshire:* Samoset Hotel, Rockland, Me., June 12–13, 1959.

*New England:* June, 5–6, 1959. Chatham Bars Inn, Chatham (Cape Cod), Mass.

*Eastern District (New England Section)*: June 1959, annual meeting with New England Section.

*Indiana District (Ohio Section)* (meetings at the Hunt Room, Marott Hotel, Indianapolis, Ind.): June 16, 1959.

*Empire State:* Whiteface Inn, Whiteface, N. Y.. June 11–14, 1959. Annual meeting.

## *Other 1959 Conferences*

| | |
|---|---|
| June 17–20 | CPPA Summer Meeting, Manor Richelieu Hotel, Murray Bay, P. Q. |
| Sept. 13–18 | Am. Chem. Society, Atlantic City, N. J. |
| Oct. 26–28 | Packaging Institute, Statler Hotel, New York, N. Y. |
| Nov. 9–11 | National Paperboard Assoc., New York, N. Y. |

## *New England*

The New England Section of TAPPI will hold its Annual Meeting on June 5 and 6, 1959, at the Chatham Bars Inn, Chatham (Cape Cod), Mass. The technical talks will include:

FRIDAY—JUNE 5 (AFTERNOON)

Kenneth W. Britt, associate research director, Scott Paper Co. Subject: "New Developments in the Internal Bonding of Paper."

H. F. Arledter, director of research, Hurlbut Paper Co. Subject: "Synthetic Fibrillating Fibers—A New Tool for Manufacture and Bonding of Long Fibered Synthetic Fiber Paper."

FRIDAY—JUNE 5 (EVENING)

Albert W. Dunning, director of market research, Plastic Coating Corp. Subject: "Unusual Opportunities in Paper Products."

SATURDAY—JUNE 6 (MORNING)

Lowell Technological Institute Student Talks for Helen U. Kiely Award

J. Earl Church, technical service representative, Rayonier, Inc. Subject: "Effect of Wood Fibers on Sheet Characteristics."

Representative of Beloit Iron Works. Subject: "High Speed Paper Formation," including a discussion of the Inverformer.

Please write E. R. McMullen, manager, Chatham Bars Inn, Chatham, Mass., for reservations. Prices are as follows:

American Plan

$16 per day per person for twin-bedded rooms.
$18 per day per person for single bed room.
Suites are available in cottages for company groups.
Rooms for Thursday night, June 4, and meals will be available for early arrivals.

Members are encouraged to bring their wives. There will be a reception for the ladies at 3 p.m. Friday afternoon. Ladies' events will be outlined at this time and they will have a chance to meet one another.

**SCHEDULE OF EVENTS**

FRIDAY, JUNE 5

| | |
|---|---|
| 12 noon | Registration |
| 3 p.m. | Technical Talks—Meeting Room H |
| | Annual Business Meeting, New England Section |
| 6 p.m. | Affiliates Cocktail Party |
| 7 p.m. | Banquet, Speaker, A. W. Dunning |
| 9 p.m. | Dancing, Main Ballroom |

SATURDAY, JUNE 6

| | |
|---|---|
| 9 a.m. | Technical Talks—Meeting Room H |
| | Helen U. Kiely Awards |
| 12:30 p.m. | Clambake on the Beach |
| 1 p.m. | Golf matches, sight-seeing boat trip, shuffleboard, tennis, bridge, swimming and sunbathing, fishing parties |
| 7 p.m. | Banquet and awarding of prizes |
| 9 p.m. | Dancing—Main Ballroom |

## *Maine-New Hampshire Section*

The program of the Annual Meeting of the Maine-New Hampshire Section of TAPPI to be held June 12 and 13, 1959, at the Samoset Hotel, Rockland, Me. follows. The general theme of the program is being developed on "The Control of Production Losses."

**FRIDAY, JUNE 12**

9:00 a.m. – 2:00 p.m. Registration
1:30 p.m. Annual Business Meeting and Election of Officers
2:00 p.m. Technical Papers:

1. "Control of Wood Losses from the Stump to the Paper Mill," Warren F. Daniell, Manager, Engineering and Research, Great Northern Paper Co.
1. "Problems of Controlling Raw Material Losses in the Paper Mill," Neal L. Martin, Assistant Divisional Chemist, Fraser Paper, Ltd.
3. "Control of Paper Machine Stock Losses," Lawrence E. Robinson, Technical Service Department, Oxford Paper Co.
4. "Control of Production Losses in the Finishing Department," D. D. Hall, Manager of Production Services, Eastern Fine Paper and Pulp Division, Standard Packaging Corp.

There will also be a program developed for the Industrial Engineering and Material Handling Group on Friday afternoon which will run concurrent with the other technical program. The details of this part of the program are as follows:

1. "Southworth Lift Table System of Trimmer Operation," Leslie Pearson, Southworth Machine Co., Portland, Me.
2. "An Incentive Payment Plan for Paper Machines," Emmett Christensen, S. D. Warren Co., Westbrook, Me.
3. "L P Gas as a Fuel for Material Handling Equipment," E. B. Denton, Keyes Fiber Co., Waterville, Me.
4. "Handling Paper Mill Materials with Lift Trucks," Films, Sumner Bryant, Field Machinery Co., West Falmouth, Me.
5. '"Perma-Web'—A Complete Wet End Break Control," by A. W. Pinkham, Jr., Curtiss-Wright Corp.

7:00 p.m. Banquet—The speaker will be Eugene H. Clapp, president of the Penobscot Chemical Fibre Co.
9:00 p.m. Dancing
12:00 Midnight. Midnight Snack

***Ladies Program***

Boat Rides
2:00 p.m. Tour to points of interest in the Rockland Area—Bridge in South Lobby
4:30 p.m. Tea in North Lobby

**SATURDAY, JUNE 13**

9:00 a.m. Panel Discussion. *Moderator:* J. J. Thomas, Associate Research Director, S. D. Warren Co. *Panel:* Messrs. Daniell, Martin, Robinson, Hall
9:30 a.m. Ladies' Putting Contest
12:30 p.m. Picnic on the Veranda
2:00 p.m. Bingo—Golf Tournament—Boat Rides—Fishing parties can be arranged
7:00 p.m. Sports Dinner and Awarding of Prizes
9:00 p.m. – Midnight. Dancing

All reservations are to be made direct to the Samoset Hotel.

Gratuities: A gratuity service charge of 15% will be added to the hotel bill to cover dining room and housekeeping services. Bellmen and other gratuities are to be on an individual basis.

American Plan rates include complete use of facilities without charge, including golf, tennis, sailing, pool, exhibit space and equipment.

## *Empire State*

The Empire State Section meeting at Whiteface Inn, Lake Placid, N. Y., on June 11–13, 1959, promises to be one of the most outstanding meetings in the history of the section. Program Chairman F. W. O'Neil of the New York State College of Forestry and his committee have spent a great deal of time obtaining good speakers and panelists for this meeting.

Afternoons will be devoted to workshop groups to discuss the papers presented during the morning sessions. Those who attend the convention will thus have an opportunity to exchange ideas with panelists and others in an informal atmosphere. Registration begins Thursday afternoon, June 11, followed by the chairman's reception during which many old friendships will be renewed.

Whiteface Inn, on Lake Placid, is noted for its friendly relaxed atmosphere and excellent recreational facilities.

**Program**

**FRIDAY, JUNE 12, 1959**

Paper Mill Cleanliness—9:30 a.m. to 12:30 p.m.
*Chairman*—Gordon Rabeler
International Paper Co., Glens Falls, N. Y.

1. "The Mechanism of Growth of Bacteria and Fungi," by Donald C. Lundgren, Department of Bacteriology and Botany, Syracuse University, Syracuse, N. Y.
2. "Slime and Odors in the Paper Mill," by Ralph T. Russell, Microbiological and Biochemical Research Center, Syracuse University Research Institute, Syracuse, N. Y.
3. "Foam Control in the Paper Mill," by D. H. Hall, Nopco Chemical Co., Newark, N. J.
4. "Felt Cleaning—Its Effect on Felt Performance and Felt Life," by James Hanchette, Huyck Felt Co., Rensselaer, N. Y.
5. "A Clean Paper Mill—The Problem and the Solution," by Fred Crane, Crane & Co., Dalton, Mass.
6. "The Manufacture of Clean Paper." Speaker to be announced.

Junior Award Papers—2:00 p.m.
*Chairman*—J. J. Forsythe, International Paper Co., Niagara Falls, N. Y.

Workshop Session on Paper Mill Cleanliness

***Panels***

1. Bacteria, Fungi, Slime and Foam Session. *Panelists:* Donald C. Lundgren, Ralph T. Russell, and D. H. Hall
2. Felt Cleaning Session. *Panelists:* James Hanchette and Lou Ward of Huyck Felt Co.
3. Clean Paper Mill Session. *Panelists:* Fred Crane, G. J. Rising of Eastern Chemicals, Inc., Rensselaer, N. Y.

**SATURDAY, JUNE 13, 1959**

Films and foils—9:30 a.m. to 12:30 p.m.
Chairman—To be announced

1. "Hot Melt Coatings," by F. R. Lehman, Dow Chemical Co., Midland, Mich.
2. "Emulsion and Solvent Coating Developments," by Clifford G. Morse, Sealright-Oswego Falls Corp., Fulton, N. Y.
3. "Use of Films and Foils in Combination with Paper," by Paul Wolper, Riegel Paper Co., Milford, N. J.
4. "Metalizing Technique for Paper Combination," by Dr. K. C. Taylor, F. J. Stokes Co., Philadelphia, Pa.
5. "The Reuse of Plastic Coated Papers," by Ralph Kumler, Waste Paper Utilization Council, New York, N. Y.
6. "The Economic Effects of Plastics" Use on the Paper Industry," by Anthony Dragonette, Bakelite Division of Union Carbide and Carbon Chemical Co., New York, N. Y.

Workshop Session on Films and Foils—2:00 p.m.

***Panels***

1. Coating Session. *Panelists:* F. R. Lehman, Clifford Morse, G. L. Booth of Dilts Machine Division of Black-Clawson, Fulton, N. Y.
2. Films, Foils and Metalizing Session. *Panelists:* Paul Wolper and K. C. Taylor
3. Economics and Reuse Session. *Panelists:* Ralph Kumler and Anthony Dragonette

On both Friday and Saturday afternoons from 2:00 to 5:00 p.m. each morning program will be divided into three workshop groups, each working for 45 min. to give everyone a chance to work at each group each afternoon.

This is the type of program in which you get a chance for personal contact with panelists and others in round table discussion. Meet your friends here for a cup of coffee and a grand afternoon.

Please make your reservations at the Whiteface Inn, Lake Placid, N. Y., immediately.

## *1959 Summer Meeting, Technical Section, Canadian Pulp and Paper Association*

The Manor Richelieu, at Murray Bay, Que. will be the scene of the 1959 Summer Meeting of the Technical Section, Canadian Pulp and Paper Association. Sessions will begin Wednesday afternoon, June 17, 1959, and will end Saturday morning, June 20, 1959.

The various committees of the Technical Section are currently engaged in preparing their portions of the program which will provide topics of interest to those engaged in all phases of the pulp and paper industry. The program is not finalized, but the following is a list of tentative topics for presentation either as papers or as group discussions:

Paper Mill Maintenance
Summary of Results of Basis Weight Measurement, Including Fiber Flow Measurement
Summary of Results of Moisture Measurement on Paper Machines
The Conversion of Steam Plants to Gas Firing
Board Mill Operating Problems
Surface Defects as Applied to Fine Papers
Reducing Steam Costs in the Paper Mill
Electrical Cleaning Solvents
New Developments in Board Drying Techniques
Panel Discussion on Board Sizing

# In Lighter-Weight Coated Papers...

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# HIGH OPACITY HORSE HEAD® R-750

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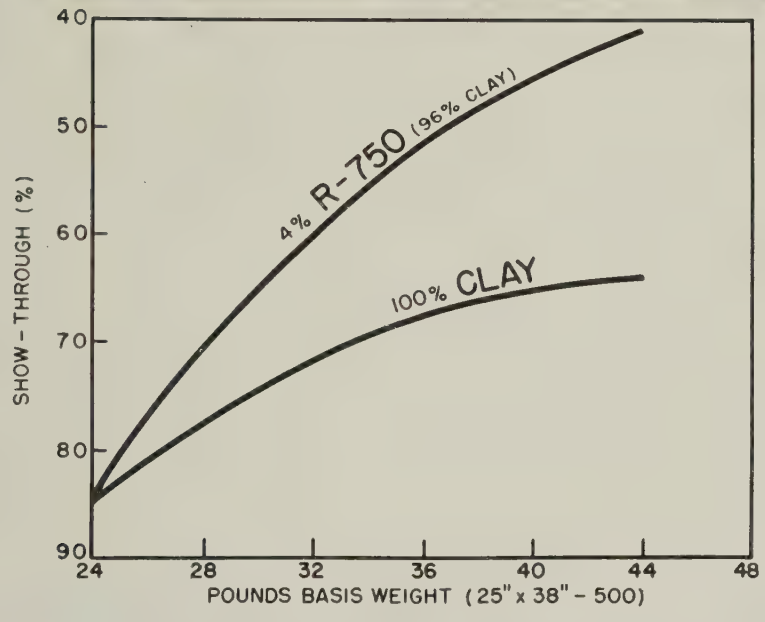


A lighter-weight sheet with greater resistance to show-through can be obtained by replacing only 4% clay with HORSE HEAD R-750 in the coating. The above results were obtained on a 24-lb. base stock coated one side only.

You need only moderate percentages of HORSE HEAD R-750 in your coating to obtain improved show-through resistance at lower basis weight. This means lower mailing costs for your customers.

*Here's why:*

**HORSE HEAD R-750,** having a rutile crystal structure, has a high refractive index . . . far higher than clay, even higher than anatase titanium dioxide.

**HORSE HEAD R-750** is economical, too. In coated papers it provides more show-through resistance per dollar than anatase titanium dioxide.

**HORSE HEAD R-750** is especially suited for use in coated papers of all types. It provides excellent color and brightness, good dispersion, low water demand, good flow properties in coating colors.

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NEW YORK, N. Y. KALAMAZOO, MICH. PORTLAND, ORE. SEATTLE, WASH.

Panel Discussion on Pitless Grinding—A New Look at an Old Technique
Comparison of Bases in the Sulphite Process
Review of Recent Work on Fundamentals of Grinding
Yellowing of Paper
Pulp Blends and Paper Properties for Newsprint
Irreversible Changes in Cellulose Caused by Drying
Panel Discussion on Operating Problems of Black Liquor Evaporators
Screw Press Washing of Kraft Brownstock
The Effect of pH Level on Cooking Rates in Sulphite Pulping

In addition to the technical program, a social program is being planned which will include a special ladies' program, a golf tournament, and a dance.

As has been the policy at previous meetings, the Technical Section will welcome nonmembers who wish to attend the Summer Meeting.

Please note that the Technical Section is unable to handle requests for accommodation. All reservations should be made through H. M. Costello, General Passenger Agent, Sales, Canada Steamship Lines Ltd., P. O. Box 100, Montreal, Que.

## *Eighth Statistics Course*

The pulp and paper technical man interested in improving his grasp of statistics is urged to apply now for the 8th CPPA-TAPPI Statistics course, to be held at Dartmouth College, Hanover, N. H., July 20–31, 1959. The textbook for the course will be sent on receipt of registration in order to permit advance preparation. Enrollment is limited to 40 in the elementary course and 15 in the seminar.

The fee for either complete course, including text, course material, board and lodging, is $280. An outline of the content of each course appeared in the April issue of *Tappi* under Association News and Events.

A registration form appears elsewhere in this issue. Members of the teaching staff for the courses are as follows:

*Geoffrey Beall*, Statistical Advisor to the vice-president for manufacture, Gillette Safety Razor Co., Boston, Mass., B.A., British Columbia, M.Sc., Illinois, Ph.D., London.

At London Dr. Beall enjoyed the last year of the professorship of Karl Pearson and the first year of that of R. A. Fisher. He worked particularly under Egon Pearson but also with Jerzy Neyman.

Dr. Beall's work has always been in experimental design and analysis. He worked for the Canadian Department of Agriculture, then for the Ontario Department of Health, then for the Institute of Paper Chemistry, Appleton, Wis. ($3^1/_2$ years), briefly in glass manufacture, briefly in meat packing (Supt., Research Laboratories), then chairman of the Department of Statistics, University of Connecticut (6 years), and most recently as statistical advisor to the vice-president for manufacture in Gillette.

Dr. Beall is the author of 72 scientific papers.

**REGISTRATION FORM**

To: Mr. A. J. Winchester
Technical Association of the Pulp & Paper Industry
155 E. 44th Street
New York 17, N. Y.

Please enroll the following persons in the Eighth Statistics Course, Dartmouth College, Hanover, N. H., July 20 to 31, 1959.

Name.....
Position.....
Course: Basic ( )
Advanced Seminar* ( )

Name.....
Position.....
Course: Basic ( )
Advanced Seminar* ( )

* If enrollment is for advanced seminar, please indicate qualifications by attached letter.

Enclosed is check for $..... for enrollent of ..... persons at $280 each. (Please make checks payable to Technical Association of the Pulp & Paper Industry.)

Company Name.....
By (Name).....
Address .....
.....

*F. R. Sheldon*, General Manager, Applications Section, Inorganic Research & Development Department, Food Machinery & Chemical Corp., Princeton, N. J.

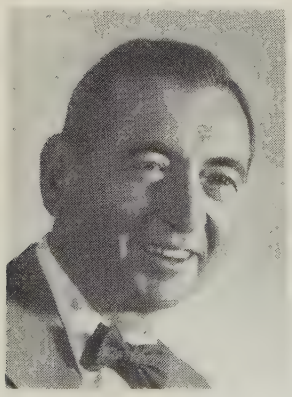
Mr. Sheldon, prior to moving to Princeton in September, 1958, had been with FMC's Becco Chemical Division since his graduation from M.I.T. in 1939. He has used statistical methods in his work on the applications of Becco's hydrogen peroxide in the pulp and paper, textile, and other industries. Co-author of several articles and patents relating to pulp processing, he is a member of the American Chemical Society, the American Society for Quality Control, the American Statistical Association, and the Technical Association of the Pulp & Paper Industry. He is past chairman of the TAPPI Statistics Short Course Subcommittee.

*John Mandel* was born in Belgium, where he was granted a master's degree in chemistry by the University of Brussels. He did graduate work in mathematical statistics at Columbia University under Hotelling and Wald.

After having worked as a chemist both in Belgium and in this country, he took a position as a statistician in the Division of Organic and Fibrous Materials of the National Bureau of Standards in Washington, D. C. In this position, which he has occupied since 1948, he acts as a consultant in statistics to chemists, physicists, and engineers engaged in research on rubber, textiles, paper, and leather.

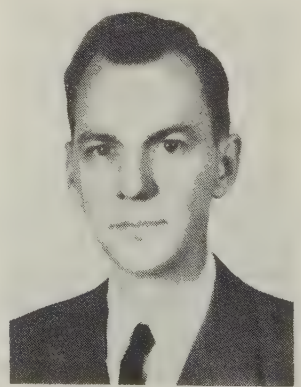
He is the author or co-author of 36 papers dealing with the development of statistical methods and their application to the physical sciences, particularly in the field of polymeric materials.

The Statistics Course is sponsored by the Statistics Com-

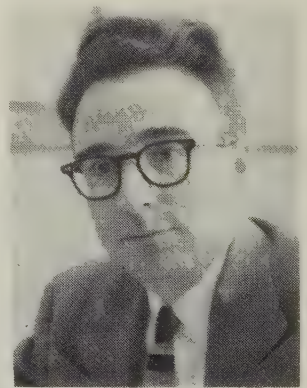


*M. S. Renner, W. R. Grace & Co., Chairman, Statistics Committee*

*Geoffrey Beall, Gillette Safety Razor Co.*



*F. R. Sheldon, Food Machinery & Chemical Corp.*



*John Mandell, National Bureau of Standards*

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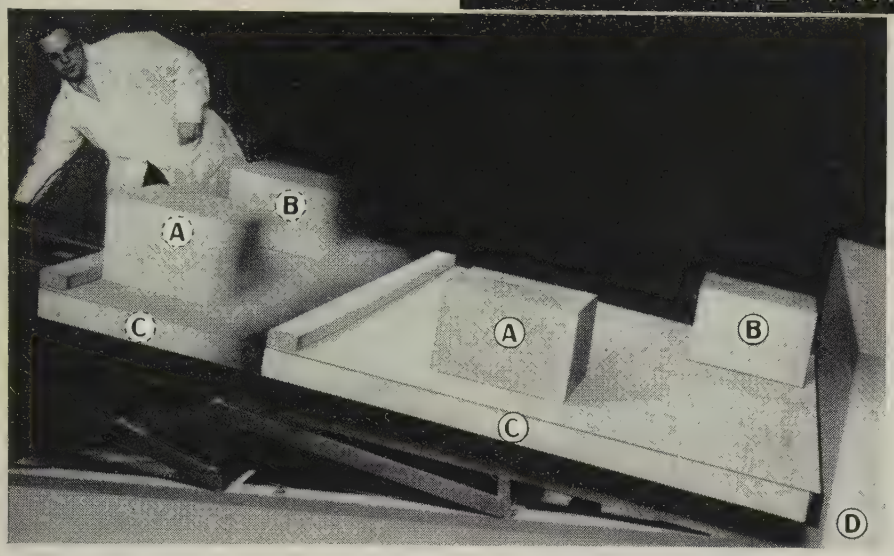
# chemical briefs

FOR THE PAPER INDUSTRY




**SLIP RESISTANCE** of boxboard containers is measured by Conbur Impact Tester which simulates impacts received by packages during shipping. Carton treated with "Ludox" (A) is placed on treated kraft paper, which covers one half the surface of the sliding inclined plane (C). Untreated carton (B) is placed on untreated kraft paper. The inclined plane is released, striking stop (D) with an impact equivalent to a dead stop at 6 mph. Repeated tests show treated cartons slide only ⅓ as far as untreated cartons.

***DU PONT ENGINEERING TESTS PROVE . . .***

## Anti-slip coatings of Du Pont LUDOX® reduce slippage of corrugated cartons by 67%

### Losses due to damage in handling and shipping greatly reduced

Invisible coatings of Du Pont "Ludox" colloidal silica on corrugated cartons can mean the difference between safe shipment and costly damage. Using the Conbur Impact Tester (above) the Du Pont Engineering Test Center simulated impacts received by packaged products during shipping. Result: Cartons treated with "Ludox" slip 60 to 70% less than untreated containers!

This fact is important since Du Pont experience shows that 75% of all damage to one-trip fiberboard cartons results from impacts received during coupling and normal starts and stops in rail shipment.

### What this means to package users

There's less damage to packaged products because of (1) reduced movement of treated packages in rail and truck shipment, and (2) greater stability of carton loads during in-plant handling. Treated packages stack solidly with less danger to personnel. And the expense of repackaging due to damage is reduced.

Coatings of "Ludox" can be applied to finished packages or to paper products by mills or converters. Treated packages resist soiling, permit sharper printing . . . increasing customer appeal of finished packages.

Names of suppliers of treated packages and more information about "Ludox" are available on request. Just fill out and mail coupon below.

## New Du Pont program offers tailor-made adhesives for paper laminates

When special adhesives are needed for strong paper-to-paper bonds, or where equipment calls for particular formulations . . . chances are Du Pont can tailor-make a Weatherproof Adhesive to fill the bill.

Manufacturers of laminated paper products are invited to take advantage of special Du Pont facilities which are available for solving adhesive problems and for compounding adhesives suited to difficult product requirements. The coupon will bring further information.

### CHEMICALS BASIC TO THE PAPER INDUSTRY

In addition to a group of specialty chemicals that offer unique benefits to end products, the Du Pont Grasselli Chemicals Department also supplies the following basic chemicals to the pulp and paper industry:

| | |
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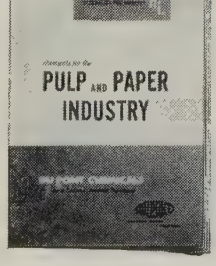
| Aluminum Sulfate | Salt Cake |
| Ammonium Sulfamate | Sodium Carbonate |
| Aqua Ammonia | Sodium Phosphate — DI |
| Caustic Soda | Sodium Tripolyphosphate |
| Copper Sulfate | Sodium Pyrophosphate |
| Diatomaceous Earth | Sodium Silicate |
| "Lignasan" X Fungicide | Sodium Sulfite |
| Mineral Adhesive Solution | Sodium Thiosulfate |
| | Sulfamic Acid |
| | Zinc Chloride |

**MAIL COUPON** for your copy of "Chemicals for the Pulp and Paper Industry," which describes the benefits made possible by Du Pont Chemicals. Perhaps you'll find new ways to improve product quality, build sales appeal. E. I. du Pont de Nemours & Co. (Inc.), Grasselli Chemicals Department, Room N-2543, Wilmington 98, Delaware.




E. I. du Pont de Nemours & Co. (Inc.)
Grasselli Chemicals Dept., Rm. N-2543T
Wilmington 98, Delaware

Please send me a copy of "Chemicals for the Pulp and Paper Industry" and more information about: ☐ Anti-slip coatings of "Ludox"; ☐ Tailor-made Weatherproof Adhesives.

*Name* _____ *Title* _____

*Firm* _____

*Address* _____

*City* _____ *State* _____

mittees of The Canadian Pulp and Paper Association, Technical Section, and the Technical Association of the Pulp and Paper Industry. Hugh Banfill, Howard Smith Paper Mills, Cornwall, Ont., is chairman of the CPPA committee; M. S. Renner, Dewey & Almy Chemical Co., Cambridge, Mass., is chairman of the TAPPI committee.

## *Certificates of Appreciation*

TAPPI's lifeblood has always been the work performed voluntarily by its members. The meetings, committee projects, local section programs, and Association publications are basically the products of such voluntary efforts. Unquestionably the headquarters staff has contributed to the success of these undertakings, but the initiative, leadership, and ultimate responsibility have remained with the individual members.

In years past any official expression of the Association's gratitude for these voluntary services was probably unnecessary. Thirty years ago TAPPI had only one local section, 17 technical committees, and roughly 1000 members. The leaders in the Association were known personally by many of the members, and there was little need for any formal recognition of their services.

Today, however, TAPPI has 13 local sections, 63 technical committees, and over 9000 members. In the last few years it has become increasingly difficult to recognize adequately those individuals performing outstanding services for the Association. With a vastly expanded paper industry and members drawn from 55 countries TAPPI has lacked a satisfactory means of expressing officially its appreciation for the dedicated efforts of its leaders.

After reviewing the practices of other technical societies the TAPPI Executive Committee has authorized granting certificates of appreciation as tokens of the Association's gratitude to these men.

When a TAPPI President retires from office, he will receive an engraved certificate of appreciation signed by the incoming President and the Secretary-Treasurer. This certificate will be presented at the Annual Luncheon in New York during TAPPI Week.

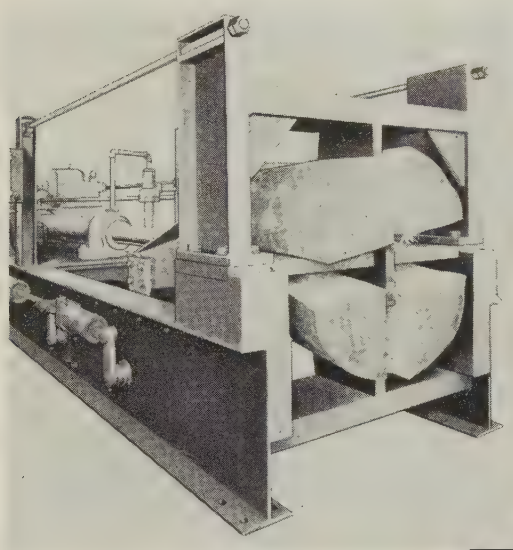
Retiring chairmen of local sections, technical divisions, and technical committees will receive certificates of appreciation signed by the TAPPI President and the Secretary-Treasurer. These certificates will be mailed to the recipient, presented at the Annual Meeting held in New York during TAPPI Week, or presented at an appropriate meeting of the local section, division, or committee, if that is preferred.

Outstanding individuals who do not qualify for recognition as retiring chairmen may also receive these certificates of appreciation. The nomination of an individual for this presentation may be made by any TAPPI member. Nominations should be forwarded to the Secretary-Treasurer with data supporting the nomination. The headquarters office will add its recommendation for approval or disapproval and submit the nomination to the Awards Committee of the Executive Committee for acceptance or rejection. Such certificates will be signed by the President and the Secretary-Treasurer and will be mailed to the recipient or presented at the Annual Business Meeting during TAPPI Week or at an appropriate local section, division, or committee meeting.

These certificates will be provided by the Association and are to be the only official awards, except for the TAPPI Medal, made in the name of the Association.

## *Paper Industry Programs for College Students*

TAPPI's College Speaking Program has now reached nearly 50 student

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**WRITE**
for proposal and quotations to meet your pulpmill requirements . . . specify maximum diameter and length of wood to be split.

Overall dimensions of MURCO Hydraulic Wood Splitter for 36" diameter wood 5'3" long are 21' long x 5'2" wide, x 5'8½" high.

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groups. Since the last report appeared in *Tappi*, 11 AIChE Student Chapters and ACS Student Affiliates have been addressed.

Response to the paper industry lecture program has been excellent and the schools have been quite liberal in their praise of TAPPI members who have volunteered their services in this educational effort.

Plans for a series of TAPPI speeches are already under way for next fall in an effort to reach even more students.

TAPPI President J. R. Lientz, Union Bag-Camp Paper Corp., states "We will carry on a big drive to encourage college students to enter the field of paper technology after graduation. Few students realize the magnitude of the paper industry and the degree to which it relies on technology and research in producing its products.... We are suffering from a shortage of technical personnel."

In addition to the schools listed in the January and March issues of *Tappi*, the following groups have sponsored paper industry lectures by TAPPI members:

Fresno State College, Fresno, Calif. ACS Student Affiliate Chapter. March 11. Speaker: Dean Ritter, Crown Zellerbach Corp., Antioch, Calif.

Clemson College, Clemson, S. C. AIChE Student Chapter. March 24. Speaker: T. E. Ramsay, Ecusta Paper Corp., Pisgah Forest, N. C.

Idaho State College, Pocatello, Idaho. ACS Student Affiliate Chapter. April 3. Speaker: M. G. Kuhlman, Potlatch Forests, Inc., Lewiston, Idaho.

University of Mississippi, University, Miss. ACS Student Affiliate Chapter—AIChE Student Chapter. April 6. Speaker: E. D. Jones, The Crossett Co., Crossett, Ark.

University of North Carolina, Chapel Hill, N. C. ACS Student Affiliate Chapter. April 7. Speaker: A. L. M. Bixler, Riegel Paper Corp., Acme, N. C.

Valparaiso University, Valparaiso, Ind. ACS Student Affiliate Chapter. April 8. Speakers: E. C. Berg, Ace Carton Corp., Chicago, Ill., and A. L. Magnuson, Potlatch Forests, Inc., Chicago, Ill.

University of Notre Dame, Notre Dame, Ind. ACS Student Affiliate Chapter. April 9. Speaker: E. E. Stephenson, Sutherland Paper Co., Kalamazoo, Mich.

University of Michigan, Ann Arbor, Mich. ACS Student Affiliate Chapter. April 15. Speaker: W. O. Kroeschell, Michigan Carton Co., Battle Creek, Mich.

Case Institute of Technology, Cleveland, Ohio. ACS Student Affiliate Chapter—AIChE Student Chapter. April 17. Speaker: J. J. Higgins, Ohio Boxboard Co., Rittman, Ohio.

Loyola University, New Orleans, La. ACS Student Affiliate Chapter. April 29. Speaker: J. J. Goss, Gaylord Container Corp., Bogalusa, La.

Baylor University, Waco, Texas. ACS Student Affiliate Chapter. May 7. Speaker: F. W. Bishop, Southland Paper Mills, Inc., Lufkin, Texas.


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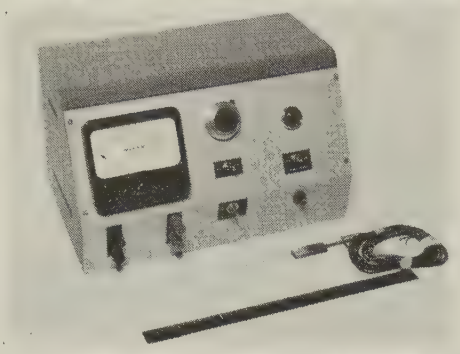

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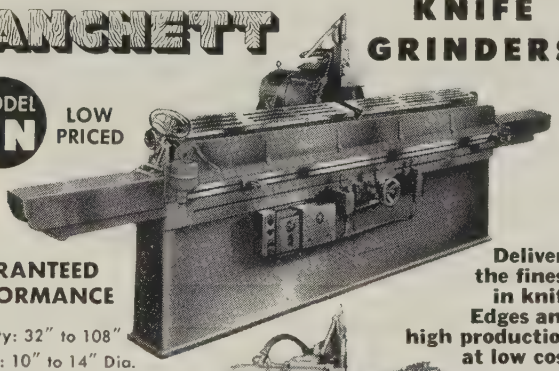

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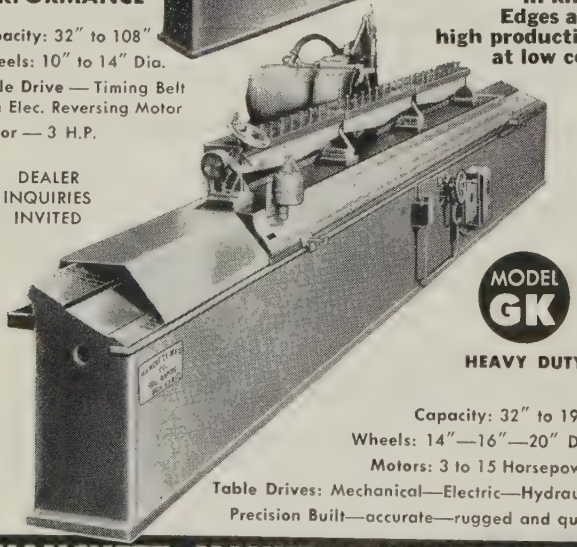

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## *Dissolving Pulp Committee*

M. A. Heath, Buckeye Cellulose Corp., Memphis, Tenn., chairman of the Dissolving Pulp Committee, has announced the appointment of Mark Plunguian as secretary for the committee.

Mr. Plunguian graduated from the New York State University College of Forestry at Syracuse and obtained advanced degrees in cellulose chemistry from the School of Forestry, University of Idaho, and the Division of Cellulose and Industrial Chemistry at McGill University. Mr. Plunguian has been engaged in industrial research in cellulose chemistry with Mead Corp., Homasote Co., Celanese Corp., and Southern Chemical Cotton Co. At present he is associated with the Virginia Cellulose Research Division of Hercules Powder Co. at Wilmington, Del. Mr. Plunguian is married and is the father of two daughters.

## *Fiber Attraction and Bonding Symposium*

A TAPPI symposium on The Fundamentals of Fiber Attraction and Bonding will be held at The Institute of Paper Chemistry, Appleton, Wis., Sept. 9–11, 1959.

This symposium is open to anyone who wishes to attend. A registration form will appear in the June issue of *Tappi*, or may be obtained by writing to TAPPI, 155 E. 44th St., New York, N. Y. Hotel reservations should be made directly by persons wishing to attend. A list of hotels and motels in the Appleton area will appear in the June issue of *Tappi*.

The tentative program for the symposium is as follows:

**WEDNESDAY, SEPT. 9, 1959**

9:30 A.M. SESSION I, PRINCIPLES OF ADHESION
*Chairman,* Roy P. Whitney, The Institute of Paper Chemistry

(a) "Fundamentals of Adhesion," by Alfred H. Nissan, Rensselaer Polytechnic Institute
(b) "Structural Aspects of Bonding," by J. A. Van den Akker, The Institute of Paper Chemistry

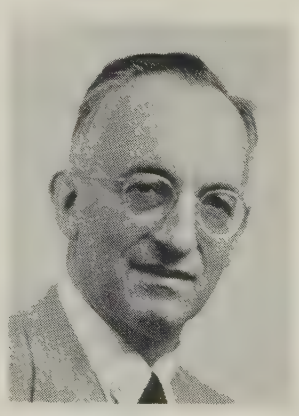
2:00 P.M. SESSION II, DEVELOPMENT OF WET WEB STRENGTH
*Chairman,* R. N. Griesheimer, The Mead Corp.

(a) "Fiber Agglomeration and Dewatering," by W. L. Ingmanson and S. T. Han, The Institute of Paper Chemistry
(b) "Wet Web Strength," by W. Brecht and R. Erfurt, Institut für Papierfabrikation, Technische Hochschule, Darmstadt, Germany
(c) "Some Aspects of Wet Web Behavior," by A. Robertson, Pulp and Paper Research Institute of Canada

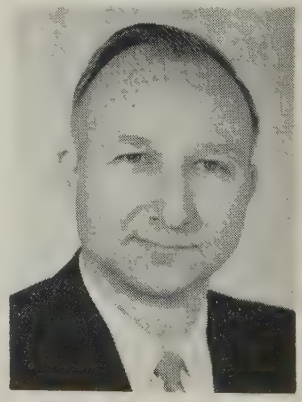
**THURSDAY, SEPT. 10, 1959**

9:00 A.M. SESSION III, FIBER PROPERTIES AFFECTING ADHESION
*Chairman,* G. K. Dickerman, Consolidated Water Power and Paper Co.

(a) "Flexibility of Fibers," by S. F. Kurath, The Institute of Paper Chemistry



*Mark Plunguian, Hercules Powder Co. Co., Secretary, Dissolving Pulp Committee*



*J. W. Swanson, The Institute of Paper Chemistry, co-chairman, Fiber Attraction & Bonding Symposium*

(b) "Drying and Shrinkage," by Harold Tarkow, U. S. Forest Products Laboratory
(c) "Fiber Geometry as Related to Adhesion," by New York State University College of Forestry

2:00 P.M. SESSION IV, DEVELOPMENT OF BONDS
*Chairman,* Dr. R. A. A. Hentschel, E. I. du Pont de Nemours & Co., Inc.

(a) "Mechanism of Bonding," by W. Boyd Campbell, Consultant, Montreal
(b) "Fiber Surface Area and Bonded Area," by J. W. Swanson, The Institute of Paper Chemistry
(c) "Bonding in Synthetic Fiber Papers," by R. A. A. Hentschel, E. I. du Pont de Nemours & Co., Inc.

**FRIDAY, SEPT. 11, 1959**

9:00 A.M. SESSION V, ROLE OF ADDITIVES IN BONDING
*Chairman,* K. W. Britt, Scott Paper Co.

(a) "Polysaccharid Adhesives," by M. L. Cushing, A. E. Staley Mfg. Co.
(b) "Mechanism of Retention of Resin Additives," by E. F. Thode, J. W. Swanson, and S. F. Kurath, The Institute of Paper Chemistry
(c) "Elastomeric Binders," by Paul J. McLaughlin, Rohm & Haas Co.

2:00 P.M. SESSION VI, PANEL DISCUSSION AND SUMMARY
*Chairman,* J. W. Swanson, The Institute of Paper Chemistry

Panel to be composed of speakers at previous sessions.

The Fiber Attraction and Bonding Symposium is jointly sponsored by the TAPPI Fundamental Research Committee and Wet Strength and Interfiber Bonding Committee. Members of the planning committee for the symposium are:

*General Chairmen:* Roy P. Whitney and John W. Swanson, The Institute of Paper Chemistry, Appleton, Wis.
*Local Arrangements Chairman:* J. J. Shipman, Kimberly-Clark Corp., Neenah, Wis.
*Publicity Chairman:* C. S. Maxwell, American Cyanamid Co., Stamford, Conn.
*Program Chairman:* R. N. Griesheimer, The Mead Corp., Chillicothe, Ohio
*Program Committee:* K. W. Britt, Scott Paper Co., Chester, Pa.; G. K. Dickerman, Consolidated Water Power & Paper Co., Wisconsin Rapids, Wis.; R. A. A. Hentschel, E. I. du Pont de Nemours & Co., Wilmington, Del.

## *Electrical Engineering Committee*

The Electrical Engineering Committee will hold an interim meeting on the morning of June 17, 1959, at Orono, Me.

This date and location will permit committee members to stay over to attend the AIEE Pulp and Paper Conference which will be held at the University of Maine, in Orono, on June 18 and 19, 1959.

It is hoped that the coordination of these activities will serve to induce attendance by those who, under other arrangements, would be unable to make two separate trips.

## *Standards Ballot*

The recent membership vote (330) on TAPPI Standards yielded the following results:

| | *For* | *Against* | *Not voting* |
|---|---|---|---|
| T 15 m, Ash in wood | 293 | 3 | 34 = 330 |
| T 211 m, Ash in pulp | 299 | 3 | 28 = 330 |
| T 227 m, Freeness | 295 | 2 | 33 = 330 |
| T 413 m, Ash in paper | 296 | 3 | 31 = 330 |
| T 452 m, Brightness of paper | 295 | 8 | 27 = 330 |
| T 602 m, Sulphuric acid | 281 | 6 | 43 = 330 |
| T 608 m, Glassware and weights | 286 | 3 | 41 = 330 |
| T 609 m, Indicators | 291 | 2 | 37 = 330 |
| T 630 m, Melting point of wax | 291 | 1 | 38 = 330 |

On the basis of the ballot returns, with the exception of T 602 m, which has been withdrawn (see below), each of the others with minor changes, will be published soon in loose-leaf form, as a Revised TAPPI Standard.

The following principal comments and suggestions were received with the ballots: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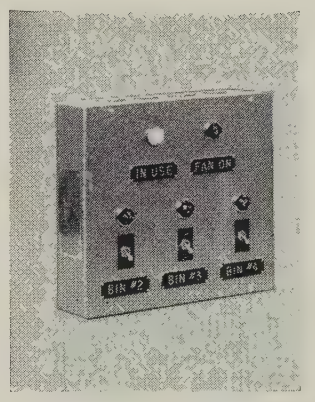


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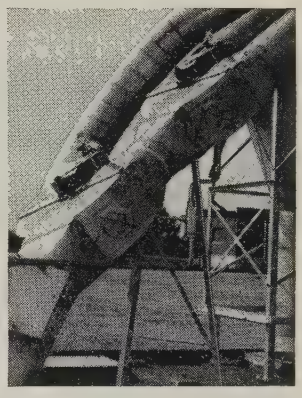

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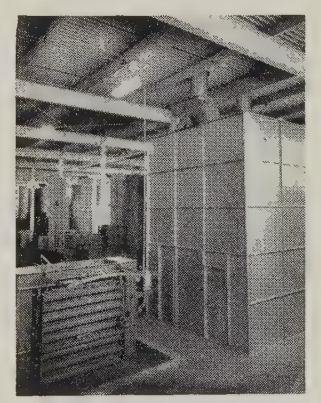

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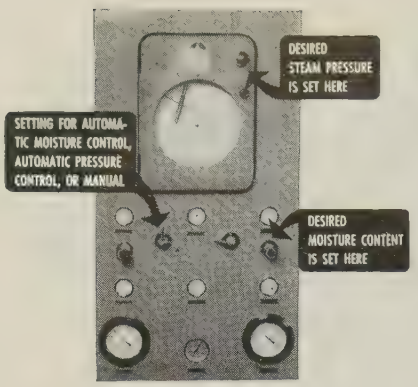
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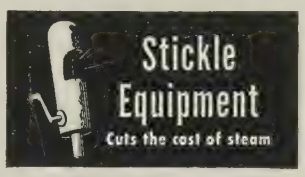


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*Ash in Wood, Pulp, and Paper* T 15 m, T 211 m, and T 413 m (*Tappi*, July, 1958). Comments were received on the disparity between the temperatures specified for ashing wood and pulp (575°C.) and paper (925°C.). The percentage of ash in wood or in pulp is measured by burning a specimen at the lowest practicable temperature so as to minimize the loss of volatile constituent inorganic matter. Paper usually is ashed to ascertain the quantity of filler *added*, and the percentage so found is frequently used as a specification. Accordingly, repeatability of the test becomes the more important objective, and the higher temperature is distinctly advantageous in this respect.

*Freeness of Pulp* T 227 m (*Tappi*, August, 1958). Among the many suggestions sent in by the membership were: (a) that the user should provide himself with both an ultimate standard reference perforated plate and one or more working reference plates; (b) the perforated plates, and at least the small orifice piece, should be made from stainless steel to avoid the corrosive effect of certain pulps and woods such as eucalyptus; (c) if a detergent is used, all traces of it should be removed by a thorough washing with pure water before making a test; and (d) that instruments in continual use should be kept full of water to avoid the problem of getting them thoroughly rewetted before each test.

*Analysis of Sulphuric Acid* T 602 m (*Tappi*, July, 1958). Enough objections to the proposed revision were made by the membership to warrant its being withdrawn for further study. Criticisms were directed to the dilution procedure, the titrant, the indicators, and the method for the iron content, which it was suggested should be determined colorimetrically after oxidation with peroxide. The final aliquot taken for titration should not read 10 ml. as printed, but 50 ml., to be $^1/_{100}$ of the original sample.

*Indicators for Volumetric Analyses* T 609 m (*Tappi*, June 1958). It was suggested that the concentrations of all the acid-alkali indicators should be 0.1%. This change is acceptable to the committees concerned and will be made.

*Brightness of Paper and Paperboard* T 452 m (*Tappi*, July, 1958). Technical objections were that the wavelength used (457 muu), and the taking of readings from the sample in the machine direction only, were both arbitrary and could be changed to advantage. It will be remembered that the method was developed originally to grade the brightness of papers for the NRA in the middle thirties, and subsequently became widely and sucessfully employed as the standard for the industry. Because results in accordance with it are included in so many specifications, it is believed that any influential change now would require considerable justification.

*Calibration of Glassware and Analytical Weights* T 608 m (*Tappi*, June, 1958). A correction to the published method appears on page 145A of the February, 1949, issue of *Tappi*.

Your comments or suggestions with respect to any of the TAPPI Standards or published methods will always be welcome at any time.

## *Regulations Governing Standards*

At the TAPPI Executive Committee meeting on Feb. 22, 1959, the following motion was passed:

Moved that, in accordance with Article XV, Section 4 of the Bylaws, we adopt the revised Regulations Governing Standards proposed by the Standard Committee in its February, 1959, memorandum. The said revision incorporates the following changes:

1. Methods are to be submitted to written rather than verbal ballot of the responsible committee.
2. Channel of communication is to be between the Standards Committee and the divisions rather than between the Standards Committee and committees.
3. Revised wording to improve clarity and incorporate certain grammatical stipulations.

The revised regulations will appear in the 1959–60 TAPPI Year Book, to be published in July, 1959.

# PERSONAL MENTION

## *Items About New and Old Tappimen*

### *New TAPPI Members*

*Herbert J. Adicks,* Sales, Bleached Liner Board, Bulkley Dunton & Co., New York, N. Y., a 1932 graduate of Colgate University.

*Walter C. Bajus,* Raw Material Engineer, Western Electric Co., Inc., Chicago, Ill., a 1952 graduate of Valparaiso University, and a degree from Purdue University in 1953.

*John P. Bosshardt,* Laboratory Technician, Mead-Atlanta Paper Co., Atlanta, Ga.

*Johan Bring,* Head Engineer, Pulp Technical Dept., AB. A. Ekstroms Maskinaffar, Stockholm, Sweden, a 1922 graduate of the Technical University of Karlsruhe.

*William Maurice Broomhall,* Managing Director, Cellulose Development Corp., Ltd., Middlesex, England, graduate of Christ's College, Cambridge.

*Robert W. Burnett,* General Superintendent, Pulp & Paper Mill, Continental Can Co., Inc., Hodge, La.

*Carlo Carcano,* Engineer, Figli Di Carcano Gerolamo, Maslianico (Como), Italy, a 1935 graduate of Germania College.

*Franco Carcano,* Engineer, Figli Di Carcano Gerolamo, Maslianico (Como), Italy, a 1942 graduate of Politecnico-Milano, Eng. D.

*Du Wayne R. Carlson,* Special Assistant to Manager of Process Controls, Champion Paper & Fibre Co., Hamilton, Ohio, a 1958 graduate of Miami University.

*Giovanni Cesconi,* Consulting Engineer, Milano, Italy, a 1922 graduate of Politecnico di Torino, Eng. D.

*Bharat Hibalal Chalishazar,* Deputy Director of Research, National Rayon Corp. Ltd., Bombay State, India, a 1948 graduate of Bombay University, and a degree from Manchester University in 1954.

*Jean Chopin,* Professor of Chemistry, Faculte des Sciences de Lyon, Lyon (Rhone), France.

*Noel N. Coe,* Group Leader, Dorr-Oliver, Inc., Stamford, Conn., a 1946 graduate of Massachusetts Institute of Technology.

*Richard H. Cipolla,* Product Manager, Johns-Manville Products Corp., Celite Div., New York, N. Y., a 1948 graduate of Columbia University.

*Gerald W. Colby,* Chief Engineer, Design & Development, Seymour Filter Co., Seymour, Inc., a 1952 graduate of Michigan State University.

*Richard I. Cole,* Senior Project Engineer, Scott Paper Co., Chester, Pa., a 1948 graduate of the University of Rhode Island.

*William H. Cooper,* Design Engineer, the Bahnson Co., Winston-Salem, N. C., a 1942 graduate of the Georgia School of Technology.

*James P. Corcoran,* Director, Box Design and Development, Central Fibre Products Co., Quincy, Ill., a graduate of Illinois Institute of Technology.

*William S. Cramp,* Manager Research & Technical Services, St. Lawrence Corp. Ltd., Montreal, Que., Canada, a 1929 graduate of McGill University.

*David W. Crookall,* Sales, Atlas Refinery Inc., Newark, N. J., attended Rutgers University.

*Eric G. A. Davegardh,* Engineer, Axel H. Agren AB, Gothenburg, Sweden, a graduate of Gothenburg Technical Institute, Royal Technical University.

*Robert E. Davis,* Process-Development Supervisor, Albemarle Paper Co., Richmond, Va., a 1952 graduate of Virginia Polytechnic Institute.

*Gian G. De Benedetti,* Mechanical Engineer, Cartiera di Germagnano, Torino, Italy, a 1951 graduate of Polytecnique Lausanne.

*Antoine V. De Laporte,* Director of Laboratory and Research, Ontario Water Resources Commission, Toronto, Canada, a 1910 graduate of Toronto University.

*Francesco De Pretto,* Representative of Engineering Works, Carlo de Pretto, Studio Tecnico Industriale, Milano, Italy, attended University of Bologna and Grenoble.

*Sara M. Dilley,* Librarian, Director of Library Services, U. S. Information Center, American Embassy, New Delhi, India.

*Dario D'Orio,* Manager of Engineering Design, Societa Costruzioni Specializzate Del Monego, Milano, Italy.

*Rudolph W. Driscoll,* Sales Trainee, Potlatch Forests Inc., St. Paul, Minn., a 1955 graduate of Yale University.

*Curtis E. Drury,* Sales Engineer, Improved Machinery, Inc., Nashua, N. H., a 1947 graduate of Tufts University.

*Thomas E. Dunn,* Engineering Supervisor, Electrical Engineering Consultant, Westinghouse Electric Corp., Richmond, Va., a 1950 graduate of Virginia Polytechnic Institute.

*Robert Dvorin,* Manager, Industrial Waste Treatment Dept., Graver Water Conditioning Co., New York, N. Y., a 1958 graduate of Newark College of Engineering.

*Arthur V. Faass,* Technical Representative, Naugatuck Chemical Div., U. S. Rubber Co., Dedham, Mass., a 1942 graduate of Syracuse University.

*Paride Fagioli,* General Manager, Cartiera Paride Fagioli, Milano, Italy.

*Carl S. Ferguson,* Research Chemist, UBS Laboratories, Inc., Cambridge, Mass., a 1925 graduate of Harvard College.

*Dorwyn C. Fryman,* Chemist, Monarch Marking System Co., Dayton, Ohio, a 1931 graduate of Wittenberg College.

*Ernesto G. Gietz,* Director, Biblioteca De La Facultad De Ingenieria, Buenos Aires, Argentina.

*Donald Gladstone,* Director of Quality Control, Coates Board and Carton, Garfield, N. J., a 1950 graduate of Michigan State University.

*George J. Goldstein, Jr.,* Sales Engineer, Acorn Corrugated Box Co., Chicago, Ill.

*Alfred Halliday,* President, the Alfred Halliday Co., Inc., Louisville, Ky., attended Franklin College.

*Howard L. Heise,* Research Director, the Gummed Products Co., Div. of St. Regis Paper Co., Troy, Ohio, a 1931 graduate of Battle Creek College.

*Hiroshi, Hirai,* Chief of Technical Section, Nagase & Co., Ltd., Osaka, Japan, a 1952 graduate of Kyoto University.

*Yosokichi Horita,* Mill Manager of Iskikawa Mill, Chuetsu Insatsu Seishi Co., Ltd.

*James E. Hungerpiller,* Assistant Superintendent, Union Bag-Camp Paper Corp., Savannah, Ga., a 1948 graduate of Georgia Institute of Technology.

*Fred Y. Inman,* Vice-President and Manager, Cleveland Electric Co. of S. C., Columbia, S. C., attended University of Florida.

*David Innes,* Corrosion Engineer, International Paper Co., Southern Kraft Div., Mobile, Ala., a 1925 graduate of University of Illinois.

*Paul F. Isenberg,* Power Engineer, the D. M. Bare Paper Co., Roaring Spring, Pa.

*John R. Jacobucci,* Sales Manager, Alkali Chemicals, Food Machinery & Chemical Corp., New York, N. Y., a 1938 graduate of University of Denver.

*Jan-Erik Janson,* Executive Secretary, the Swedish Plastics Federation, Stockholm, Sweden, a 1941 graduate of Boras Technical College.

*Robert A. Jedeiken,* Paper Consultant, Keuffel & Esser Co., Hoboken, N. J.

*Earl A. N. Johnson,* Engineer, Dorr-Oliver, Stamford, Conn., a 1941 graduate of University of Washington.

*Roy I. Jones,* Director of Industrial Engineering Div., Giffels and Rossetti, Detroit, Mich., a 1922 graduate of Rensselaer Polytechnic Institute.

*Harold Karner,* Microbiologist, Troy Chemical Corp., Newark, N. J., a 1956 graduate of Vanderbilt University.

*Wilhelm H. M. Klauditz,* Director of Institut fur Holzforschung, Braunschweig-Kralenried, Germany, a 1928 graduate of Technical Hochscule, Eng. D.

*Heikki Antero Klemetti,* General Superintendent, Pulp and Paper Mill, Tammerfors Linne- och Jern-Mfr. AB, Inkeroinen, Finland, a 1943 graduate of Finland's Institute of Technology.

*Manuel Koutrakis,* Laboratory Section Supervisor, UNS Chemical Corp., Cambridge, Mass., a 1946 graduate of Northwestern University.

*Charles A. Lamb,* Chief, Fluid Mechanics Lab., Kimberly Clark Corp., Neenah, Wis., a 1945 graduate of University of Iowa.

*Kenneth B. Latimer,* Department Head, Paper and Coating Research and Development, Springdale Laboratories, Time Incorporated, Springdale, Conn., a 1935 graduate of University of Western Ontario and a degree from University of Michigan in 1938.

*James F. Laundrie,* Chemical Engineer, U. S. Forest Products Laboratory, Madison, Wis., a 1955 graduate of University of Wisconsin.

*Paul E. LaValley,* Manager of Mechanics Research, Fiber Products Research Center, Inc., Beaver Falls, N. Y., a 1939 graduate of University of Massachusetts and a degree from University of New Hampshire in 1941.

*Ingvar Lindholm,* Mill Manager, Swedish Cellulose Co., Sundsvall, Sweden, a 1936 graduate of the Royal Technical University.

*Howard A. Lundeen,* Quality Control Manager, Raymond Bag Div., Albemarle Paper Co., Middletown, Ohio, a 1949 graduate of the University of Minnesota.

*Richard H. Markowitz,* Sales Engineer, John Waldron Corp., Highland Park, N. J., attended Rutgers University and Newark College of Engineering.

*Robert E. Marks,* District Manager, the Sharples Corp., Philadelphia, Pa., a 1943 graduate of the University of Rochester.

*Millender M. Matthews,* Chief District Engineer, E. F. Drew & Co., Inc., a 1932 graduate of University of North Carolina.

*James Mawdesley,* Vice-President, H. M. Spencer, Inc., Holyoke, Mass.

*Merrill F. McElroy,* Project Chemist, East Texas Pulp and Paper Co., Evadale, Tex., a 1946 graduate of University of Bishop's.

*Okada Minoru,* Chief Chemist, Kokoku Rayon & Pulp Co., Toyama City, Japan, a 1947 graduate of Kyoto University.

*William E. Morris,* Group Leader, Plastics & Coal Chemicals Div. of Allied Chemical, New York, N. Y., a 1956 graduate of Newark College of Engineering.

*Philip H. Murphy,* Plant Engineer, Crane & Co., Inc., Dalton, Mass, a 1952 graduate of the University of Maine.

*Masuo Naito,* Director of the Research Laboratory, Nitto Boseki Co., Fukushima-ken, Japan, a 1939 graduate of Tohoku University.

*Ralph W. Noe,* Student, State University College of Forestry, Syracuse, N. Y.

*Carroll D. Owensby,* Senior Process Engineer, Pulp Mill, Marathon Southern Corp., Butler, Ala., a 1941 graduate of Columbia University.

*Herman D. Parks,* Engineer, Time Inc., Springdale Labs Div., Springdale, Conn., a 1944 graduate of New Mexico College.

*Albert J. Phiebig,* American Representative, Instituto Agronomico do Estado de Sao Paulo, Campinas, Brasil.

*Victor J. Porth, Jr.,* Vice-President, Interchemical Corp., Printing Ink Div., New York, N. Y., a 1940 graduate of Northwestern University.

*Czeslaw Pustenik,* Director, Pulp and Paper Research Institute, Lodz, Poland, a 1946 graduate of Technical University, Warsaw.

*Julius Rapp,* Manager, Eastern Adhesive Div., Stein, Hall & Co., Inc., New York, N. Y., a 1942 graduate of the City College of New York and a degree from Polytechnic Institute in 1948.

*John Reyne,* General Manager, Key Chemicals Corp., Miami Springs, Fla., a 1937 graduate of City College of New York.

*Leo J. Rose,* Production Staff, Champion Paper & Fibre Co., Hamilton, Ohio.

*Robert J. Roseberry,* Chief Chemist, West Virginia Pulp & Paper Co., Tyrone, Pa., a 1935 graduate of St. Francis College.

*Arthur E. Rozin,* President, Loroco Industries, Inc., Lancaster, Ohio.

*Ulf Sandberg,* General Superintendent, Fridafors Fabriks AB, Fridafors, Sweden, a 1951 graduate of the Royal Institute of Technology.

*James E. Schad,* Process Control Engineer, Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis., a 1955 graduate of New York State College of Forestry.

*Adalbert F. Schmid,* Chemical Engineer, Paper Manufacturers Co., Philadelphia, Pa., a 1936 graduate of Staatl. Hochschule f. angewandte Technik.

*Alan M. Schwartz,* Quality Control Manager, David Weber Co., Philadelphia, Pa., a 1959 graduate of LaSalle College.

*Gian L. Sertorio,* Mill Manager, Cartiera Subalpina Sertorio, Torino, Italy.

*Frederick F. Seymour, Jr.,* Student, Lowell Technological Institute.

*Tohei Shiraishi,* President, Shiraishi Sangyo Co., Ltd., Osaka, Japan, a 1941 graduate of Naval College.

*Nadeem U. Siddiqui,* Quality Control Engineer, Standard Paper Box Mfg. Co., Ltd., Montreal, P. Q., Canada, a graduate of Edinburgh University.

*Anning H. Smith,* Eastern Sales Director, Northern Engineering Works, Detroit, Mich. and President, Smith Handling Systems, Inc., Union City, N. J., a 1941 graduate of New York University.

*John W. Smith,* Development Chemical Engineer, Process Development, The Buckeye Cellulose Corp., Memphis, Tenn., a 1955 graduate of Vanderbilt University.

*Robert P. Smith,* Quality Control Manager, Sensitized Products & Chemicals, Haloid Xerox, Inc., Rochester, N. Y., a 1945 graduate of Brown University.

*William A. Snyder,* Project Engineer, Scott Paper Co., Chester, Pa., a 1956 graduate of Lehigh University.

*Carl G. Sproul,* Research Chemist, UBS Laboratories, Inc., Cambridge, Mass., a 1941 graduate of Franklin Technical Institute.

*Donald M. Tanguay,* Chemical Engineer, Cuno Engineering Corp., Meriden, Conn., attended Yale University.

*Robert C. Wade,* Manager of Technical Marketing, Metal Hydrides, Inc., Beverly, Mass., a 1942 graduate of Oberlin College.

*Clarence E. Waful,* Chief Chemist, St. Regis Paper Co., Deferiet, N. Y., a 1948 graduate of Clarkson College.

*Harold L. Warner,* Development Engineer, P. H. Glatfelter

Co., Spring Grove, Pa., 1942 graduate of Pennsylvania State College.

*Harry N. Westall,* Director, Engineering & Maintenance, Southern Paperboard Corp., Port Wentworth, Ga.

*Malcolm C. White,* Supervisor, Materials Handling and Storage, Oxford Paper Co., Rumford, Me., a 1942 graduate of Boston University College of Business Administration.

*Jay R. Willner,* Staff, Roger Williams Technical & Electrical Services, Princeton, N. J., a 1950 graduate of Massachusetts Institute of Technology.

## *TAPPI Notes*

*Frank M. Alexander* is now Chief Engineer of the Paper Division of Industrial Nucleonics Corp., Columbus, Ohio.

*Patricio Asenjo,* formerly of Corporacion de Fomento is now Assistant to the Chief Forester of Cia Mfrs. de Pepeles y Cartones S/A, Concepcion, Chile.

*J. Stanley Babbitt,* formerly Manager of Gair Co. of Canada is now with the Crown Cork Division, Continental Can Co. of Canada, Ltd., Ville La Salle, P. Q., Canada.

*Hugh M. Banfill* is now Technical Control Superintendent of Howard Smith Paper Mills Ltd., Cornwall, Ontario.

*Arthur A. Bernhardt* is now Manager of the Nekoosa-Edwards Paper Co., Nekoosa, Wis.

*Harold C. Bice* of E. I. duPont deNemours & Co. Inc. has been transferred from Charlestown, Ind. to the Carney's Point Process Laboratory, Pennsgrove, Pa. as Senior Supervisor.

*Earl M. Brennan,* formerly of Alpha Cellulose Corp. is now in the Pulp and Paper Technical Service Department of Riordan Sales Corp. Ltd., New York, N. Y.

*Kenton J. Brown,* formerly of the Forest Products Laboratory is now Director of Research for E. D. Jones & Sons, Corp., Pittsfield, Mass.

*Ronald J. Cabot,* formerly Chemist for Canadian Wallpapers Mfgrs. Ltd. is now with Archer-Daniels-Midland Co. (Canada) Ltd., Toronto, Ontario.

*George H. Cash,* formerly with Industrial Air Co. is now Technical Consultant for Mead Pulp Sales Inc., New York, N. Y.

*Marshall J. Charlton,* Quality Control Manager of the Forest Products Division of Olin Mathieson Corp., has been transferred from West Monroe, La. to Joliet, Ill.

*Everett W. Clem,* formerly Vice-President has retired and is now a Consultant to Rice Barton Corp., Worcester, Mass.

*James G. Crump, Jr.* is now Control Superintendent of the Great Northern Paper Co., Millinocket, Me.

*Thomas P. Czepiel,* formerly Student at the Institute of Paper Chemistry is now Research Group Leader, Chemical Research for Scott Paper Co., Chester, Pa.

*Manuel Firmino Da Costa,* formerly of the Laboratorie de Technologia de Cellulose is now Director of Companhia Do Papel Do Prado, Lisbon, Portugal.

*Ralph A. Davis* of Champion Paper & Fibre Co. has been transferred from Pasadena, Tex. to Sao Paulo, Brazil as Assistant Superintendent.

*James G. Dunlap* is now Assistant to the Superintendent of Rhinelander Paper Co., Rhinelander, Wis.

*Carl Fahlstrom* has retired from the Longview Fibre Co. and is now residing at 3215 N. E. Nichelos Blvd., Longview, Wash.

*Myron F. Flotow,* formerly of Monadnock Paper Mills, Inc., is now Production Manager of Mohawk Paper Mills, Cohoes, N. Y.

*Eli H. Franklin,* formerly of Seaboard Container Corp. is now Production Manager of the Paper Products Division, Owens-Illinois Glass Co., Long Island City, N. Y.

*W. F. Gillespie* is now Division Vice-President of the Gaylord Container Corp., Division of Crown Zellerbach Corp., Bogalusa, La.


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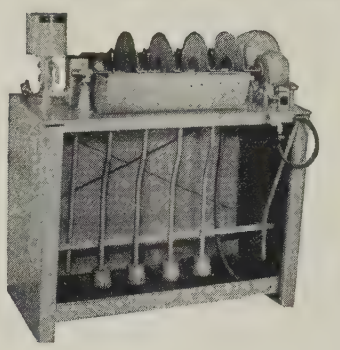

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**Chemipulp Process, Ltd., 253 Ontario St., Kingston, Ont.**

**Pacific Coast Representative**
**A. H. Lundberg Inc., P. O. Box 186, Mercer Island, Wash.**

*H. Ray Hall*, formerly of Riegel Paper Corp. has returned to Allied Paper Corp., Kalamazoo, Mich.

*Kenneth B. Hallas*, formerly of Dixie Cup Division is now Engineer for E. D. Jones & Son, Corp., Pittsfield, Mass.

*William V. Hanson*, formerly Assistant Production Manager of Champion-International Co. has been transferred to the Oxford Paper Co., New York, N. Y.

*Raymond G. Hart*, formerly of Stevens Paper Mills, Inc. is now Technical Director of Romar Tissue Mills, Inc., Wheelwright, Mass.

*Sylvester M. Hesser*, formerly Director of Thames Board Mills Ltd. is now with Colthrop Board & Paper Mills Ltd., Thatcham, Newbury, Berks, England.

*John H. Heuer* is now Vice-President, Manufacturing for the Great Northern Paper Co., Millinocket, Me.

*Jack W. Holland*, formerly with the Stocker Mfg. Co. is now with the Holland Mfg. Co., Succasunna, N. J.

*Bert Jones*, formerly Assistant Chief Chemist of the Rome Kraft Co. is now in the Sales Service Department of the Mead Corp., Chillicothe, Ohio.

*Glenn L. Jorn* of the Western Gear Works has been transferred from Seattle, Wash. to Houston, Tex. as Division Marketing Manager.

*Ralph C. Keef*, formerly of the U. S. Army has returned to Ketchikan Pulp Co., Ketchikan, Alaska as a Chemical Engineer.

*David J. Kraske*, formerly Student at the Institute of Paper Chemistry is now in the Research Department of the Oxford Paper Co., Rumford, Me.

*Robert E. Lee, Jr.*, formerly of Peter J. Schweitzer, Inc. is now Chief Chemist for the Rochester Paper Co., Rochester, Mich.

*Otto M. Lipscomb, Jr.*, formerly of the Bordon Co. is now a Paper Chemist in the Product Development Laboratory of Morningstar-Paisley Inc., Hawthorne, N. J.

*Frederick R. Lynch* of the Continental Can Co. has been transferred from Piermont, N. Y. to Tonawanda, N. Y. as a Project Engineer in the Boxboard Plant.

*Harold N. Malmberg* of the Mill Division of Owens-Illinois Glass Co. has returned to Big Island, Va. from Jacksonville, Fla.

*Frank A. Mather*, formerly of the Chemical Division of Goodyear Tire & Rubber Co. is now with Para-Chem, Inc., Philadelphia, Pa.

*James McGovern*, formerly Plant Supervisor for the American Boxboard Co. Inc. is now with the Chippewa Paper Products Co. Inc., Chicago, Ill.

*Burt Mendlin* is now Production Manager of the Container Division of Cornell Paperboard Products Co., Milwaukee, Wis.

*Winslow B. Mills*, Manager of the St. Regis Paper Co. has been transferred from Pensacola, Fla. to Watertown, N. Y.

*A. Nelson Myers* is now Vice-President of the Texas Gulf Sulphur Co., New York, N. Y.

*Richard J. O'Brien*, formerly Chemist for DuPont is now Process Engineer for the National Vulcanized Fibre Co., Newark, Del.

*Thomas W. Orr*, formerly a Marathon Corp. is now Technical Service Supervisor for Marathon Southern Corp. Division of American Can Co., Naheola, Ala.

*Sei Woung Park* is now Chief Engineer of Kyung Yang Industry Co., Seoul, Korea.

*Vincent P. Petrucelli*, formerly of the Socony Vacuum Laboratories is now a Chemical Engineer with Butterfield-Barry, Inc., Teterboro, N. J.

*Alessandro Rizzi*, formerly of Papermanufacturing S. Cesario is now a Chemical Engineer for Fibra Vulcanizzata & Cartiere Prealpine, Milano, Italy.

*Jorge R. Roldan*, formerly with Aserraderos Gonzalez S/A is now Technical Advisor for Construction y Diseno Industrial S/A, Mexico D. F., Mexico.

*Milton D. Schrieber*, formerly of West Chemical Products Co. is now doing coating research for Keuffel & Esser Co., Hoboken, N. J.

*Waldeman Seton* of the Western Kraft Corp. has been transferred from Albany, Ore. to Portland, Ore. as a Project Chemist.

*Charles M. Sigvart* is now Manager of Manufacturing Operations for the Nekoosa-Edwards Paper Co., Port Edwards, Wis.

*Fred H. Smith*, formerly of Toresdale Machine & Molding Co., Inc. is now Managing Director of Manton-Gaulin Mfg. Co., Inc., Everett, Mass.

*Thomas Somerville* is now Group Chief Chemist for Reed & Smith Ltd., Watchet, Somerset, England.

*John W. Welch*, formerly of the Lee Paper Co. is now with F. C. Huyck & Sons, Rensselaer, N. Y.

*Eugene H. Williams* is now Technical Director of the Scott Paper Co., Detroit, Mich.

*Robert R. Young* of the Pollock Paper Co. has been transferred from Columbus, Ohio to Middletown, Ohio as Quality Control Supervisor.

* * *

*N. G. McLean* has succeeded *G. R. Kuhlman* as the corporate representative of Personal Products Corp. in Milltown, N. J. in TAPPI.

*Robert E. Byrd* has succeeded *F. Williamson* as the corporate representative of National Board & Paper Mills Ltd., Granagh, Waterford, Eire in the Technical Association.

* * *

*William K. Shockley*, Product Manager of the Paper Division has succeeded *Thomas D. Johnson* as the official representative of Reichhold Chemicals, Inc., White Plains, N. Y. in TAPPI.

*William F. McDonald*, Asst. Manager PSL has succeeded *W. V. Funk* as the official representative of U. S. Industrial Chemicals Co., Tuscola, Ill. in TAPPI. Mr. Funk represented National Petro-Chemicals Corp. which has been dissolved and is now a part of U.S.I.C. Co.

## *Industry Notes*

### Production

Paper and board production during January amounted to 2,747,054 tons. This was 9% above the 2,524,357 tons produced in January a year ago. Paper production amounted to 1,230,878 tons, which was 7% above the 1,148,564 tons produced in January a year ago. The output of paperboard during this month was 1,260,321 tons, reflecting on 11% increase above the production of 1,139,153 tons reported for January, 1958.

### Pulpwood

Pulpwood receipts at the pulp mills in January amounted to 3,180,799 cords, with consumption at 3,201,527 cords. Month-end inventories increased slightly to 5,943,046 cords.

### Wastepaper

Consumption of fibrous materials other than pulpwood, totaled 816,217 tons in January, compared to 775,711 tons in December, 1958. Inventories of 983,572 tons at month's end reflected a 1% increase over end of December inventories. Consumption of wastepaper amounted to 731,738 tons, as compared to the 689,836 tons consumed in January a year ago.

### Wood Pulp

Wood pulp production during January amounted to 1,951,472 tons as compared to 1,855,919 tons produced in January a year ago.

Wood pulp consumption in the paper and board mills

during January, amounted to 2,011,882 tons, compared to the 1,879,373 tons consumed in January a year ago.

Wood pulp inventories at the end of January at the paper and board mills, amounted to 551,312 tons, as compared to 546,005 tons reported at the end of December. Month-end stocks of the pulp mills were 275,051 tons, as compared to 254,823 tons reported at the end of December.

### Review

The postwar history of the paper industry, especially its reactions to the recent recession, seems to indicate a stability and maturity that prior to World War II was noticeable by its absence.

However, one weakness still exists, according to an assessment of the industry by the Alexander Hamilton Institute, New York, N. Y. and that is the lack of adequate research. Like most industries, paper production declinded during the first half of 1958 but output for the rest of the year was above average. "As a result," the institute states, "paper and paperboard output in 1958 equalled that of 1957 and was only 2% below the record volume of 1958. . .this performance during a year of recession was all the more gratifying to paper industry leaders in that the industry had been noted for its sudden ups and downs right up to World War II."

An expanded market for paper products plus the benefits of integration techniques and mergers are the reasons given for this newly acquired stability. Also, the recognition within the industry of the need for more research would seem to indicate that this problem will soon be overcome.

### Pacific Northwest

Effects of the 1958 business recession upon the Pacific Northwest pulp and paper industry are revealed in the latest economic survey of Oregon and Washington conducted for the Northwest Pulp and Paper Association and released in the *Northwest Pulp & Paper News*.

During the year, when tightened conditions intensified competition with other areas for existing markets, combined production in the two states of pulp, paper and board rose 1.7%. Pulp production in the two states dropped 1.3%, which compares with a national drop of 0.3%. Paper and board production in the two states rose 5.8%, compared with a national increase of 0.4%.

Previous surveys, for 1947, 1951, 1956, and 1957, reflected increases in all 10 economic categories covered. The 1958 survey shows declines in seven categories, including employment, pulp production, volume of wood consumed, value of wood consumed, value of products, state and local taxes, and value of services and goods purchased in addition to wood.

Despite a slight drop in the number of people employed in the two states, wages went up substantially, with a total dollar volume increase in payrolls of nearly $2.75 million.

An outstanding trend revealed by the survey is the continued improvement in the use of raw materials. Percentage of chips, mill leftovers, and farmerwood that went into pulp production increased nearly 8%, to a total of more than 59% of all raw materials. This resulted in a corresponding decrease in the percentage of logs cut for pulping—a measure of better utilization and increased conservation on the part of the industry.

In 1947, farmerwood and chips each accounted for only 9% of raw material used, 82% being logs. In 1958, farmerwood and chips amounted to 56% of the total. Importance of farmerwood—wood grown by land owners as a second crop after their regular agriculture—is shown by the fact that in 1958 the industry paid out nearly $13 million in Oregon and Washington for this raw material.

The industry continued to build for the future, capital investment increasing more than $45 million in 1958 to a total of $648,343,791.

Following are the 10 economic categories with 1958 volumes and dollar amounts for the two states:

| | *Oregon* | *Washington* | *Total* |
|---|---|---|---|
| Number of mill employees | 4,234 | 14,785 | 19,019 |
| Dollar value of mill payroll | $ 24,636,299 | $ 81,269,021 | $105,905,320 |
| Capital investment | $154,955,782 | $493,388,009 | $648,343,791 |
| Pulp capacity in tons | 813,811 | 2,542,913 | 3,356,724 |
| Paper and board capacity in tons | 896,230 | 1,721,532 | 2,617,762 |
| Volume of wood consumed in cords | 1,338,918 | 4,397,506 | 5,736,424 |
| Value wood purchased | $ 21,520,692 | $ 84,838,782 | $106,359,474 |
| Value, products shipped | $135,643,964 | $438,888,665 | $574,532,629 |
| Payment, state & local taxes | $ 3,315,588 | $ 7,890,687 | $ 11,206,275 |
| Value, goods & services purchased | $ 32,084,588 | $152,752,008 | $184,836,596 |

### Argentina

Argentina will begin producing its first coated book paper in 1960 with a new machine powered by Westinghouse electrical equipment, it was announced recently.

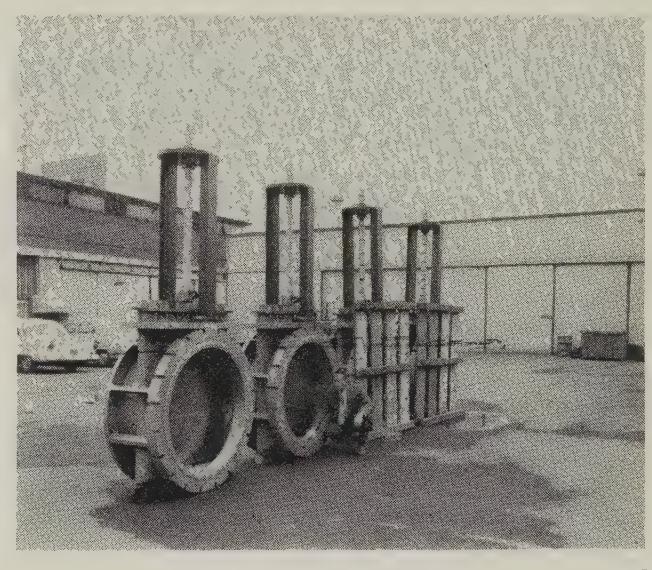
Over $1 million in motors and controls have been sold by the Westinghouse Electric International Co. to Beloit Iron Works, which is building the machine for Celulosa Argentina, S. A., of Buenos Aires. Celulosa, now carrying out an extensive expansion program, has secured a $6.5 million credit from the Export-Import Bank and will install $8 million in U. S.-produced equipment.

Book paper will be produced by the new machine at a top speed of 1500 f.p.m., or about 33,000 tons annually, according to R. L. Jeans, vice-president of Westinghouse International.

Electrical equipment for the machine will be made by Westinghouse at plants in East Pittsburgh and Sharon, Pa., Buffalo, N. Y., and at the Boston, Mass. manufacturing and repair plant.

### Cuba

A pulp mill in Cuba is using six huge stainless steel valves for capping the digesters which will be used to process bagasse. Believed to be the biggest of their type in the world, the



***Stainless steel valves for bagasse digesters manufactured by W. G. Rovang & Assoc., Inc.***

valves were made by W. G. Rovang and Associates, Inc., Portland, Ore., which specializes in building corrosive resistant valves for use in the paper, petroleum, and chemical processing industries. Materials used are stainless steel, special alloys, and new plastics.

The large Rovalves were requested so that bagasse bales could be put directly into the digesters, to save one or more handling operations. The capping valves have openings of 48 in., and are 15 ft. long. Each valve weighs 6500 lb., and with air motor attached for mechanized opening and closing of the gate, will weigh 4 tons. Gates are of special alloy, valve bodies of stainless steel.

### Australia

Thomas B. McCabe, president of Scott Paper Co., Chester, Pa., and Sir Eric Bowater, chairman of the Bowater Paper Corp. Ltd., London, England announced the inauguration of a new joint enterprise in Australia in which the Bowater and Scott interests will own equal shares.

The company, to be jointly owned and which will adopt the name Bowater-Scott Australia PTY Ltd., presently conducts a converting operation near Melbourne, Victoria, and will proceed immediately with the erection of a tissue mill at that location, involving a capital expenditure of some $4,200,000.

The paper mill and adjoining conversion plant will be the first integrated operation of its kind in Australia.

The Bowater organization is the largest manufacturer of paper in the United Kingdom and one of the largest manufacturers of newsprint in the world. It has had an extensive paper business in Australia for nearly 40 years and is a large supplier of newsprint to every metropolitan and provincial newspaper in the Commonwealth and New Zealand.

Scott Paper Co. is the leading producer of household paper products and is already associated with Bowater in the manufacture of these products by Bowater-Scott Corp. Ltd. in England.

### Finland

The chipboard (wood particle board) industry is still young in Finland. When manufacturing methods had been experimented and improved and there was experience to draw on, Finland, too, began building chipboard mills and it is now only two years ago that the first mill in this line started production.

As far as is known, several wood-working companies considered the establishment of a chipboard mill in the early 1950's and drew up preliminary plans. Four of them were realized and all of them started their building work in 1955–1956. The completion of the mills was hampered greatly by the delay in machine deliveries from abroad and it was not until 1958 when the last of them were finished.

Viiala Oy was the first to build a chipboard mill in 1955. It was planned for two production lines. Production on one of them, extruded board, was started in the autumn of 1956. The production capacity of this line is 10,000 cu.m. per annum of veneer-surfaced single-layer solid or hollow board. The other line at the Viiala mill, 3-layer flat-pressed chipboard, was started in the summer of 1957. Its production capacity is 40,000 cu.m. per annum. In the autumn of the same year, Hämeen Vaneri Oy, in its mill in Hämeenlinna, started the production of 3-layer chipboard, with a capacity of 15,000 cu.m. per annum. At the beginning of 1958 a mill, production capacity 16,000 cu.m. per annum, turning out 3-layer flat-pressed chipboard was completed at Jyväskylä for the Oy Wilh. Schauman Ab. The fourth is the Sokopan-mill of SOK Vaajakosken tehtaat (SOK=Finnish Cooperative Wholesale Society). This plant with an annual production capacity of 40,000 cu.m. also turns out 3-layer flat-pressed chipboard.

A common feature of all the chipboard mills of Finland is that they utilize as their raw material both industrial waste wood and thinnings etc. small timber. All the particles are of cutter-type and made by special machines. No shavings from the woodworking machines are utilized. The products of all these mills are also of the same type, flat-pressed 3-layer board, the surface layer of so-called fine particles and the middle layer also made by knife-cutting machines. In addition, one mill, mentioned above, also manufactures extruded chipboard. Although the basis of the manufacturing process is thus roughly the same at all the mills, there are differences of detail in the manufacturing technique. The density of all the boards is 600–650 kg. per cu.m. They are intended first and foremost for the furniture industry. The manufacture of chipboard for other purposes is at present on a very small scale.

The total production capacity of Finland's chipboard industry is about 120,000 cu.m. per annum. As all the plants are new—some of them only started this year—production in the industry has not yet risen to capacity level. At present, autumn, 1958, chipboard production totals 4500 cu.m. per month which corresponds to an annual output of 50,000 cu.m. Less than half of the capacity, thus, seems to be utilized at present. It must, however, be noted that the capacity is calculated for board of a thickness of $^3/_4$ in. (19 mm.), while the main emphasis in production is on thinner boards, average thickness perhaps 10–12 mm. For this thickness the production capacity is approx. 80,000–90,000 cu.m. per annum. The mills are thus now working at about 60% of capacity.

About a half of the present chipboard production is sold at home, half exported. In the early part of the year domestic sales were still slightly preponderant, but of late exports have increased. Chipboard is exported chiefly to European countries. There are several foreign buyers: Scandinavia, England, West European countries, Greece and other Mediterranean countries, and East European countries (Poland, Eastern Germany, Hungary, etc.). Outside Europe, chipboard is sent, e.g., to the U. S., but so far on a relatively small scale only. It is worthy of note that there are many buyers and exports are thus spread over a large area.

The domestic use of chipboard at present is 3.5 kg. per inhabitant per annum (1 cu.m. = 600 kg). In Germany the corresponding figure for 1958 is about 7 kg. per inhabitant. Statistical data on the different countries are not complete. In Austria the use of chipboard per inhabitant is 3-3.5 kg. and in England it is estimated that it will be in the near future 1.0 kg.

The main user of Finnish chipboard is at present furniture industry and, therefore, the possible growth of chipboard production is connected with the growth of that industry. Another notable field of utilization where one would expect the chipboard to gain much more ground is the building industry. Some other users of chipboard, principally the shipbuilding and wagon-making industries, will probably increase their consumption.

Despite its youth, Finland's chipboard industry already has an established position among the woodworking industries. Production has already increased to totals which are of importance in both domestic trade and exports. It also seems that this industry has good prospects in Finland.

From *Finnish Paper and Timber* No. 9, 1958.

### France

Recent developments in the production of mechanical pulp from chips are being reflected on the European scene. The first mill in Continental Europe to use the straight mechanical pulp and untreated chips process is being installed at Papeteries de Clairefontaine, Etival, Vosges, France.

Bauer double disk refiners are being used for defibering the chips in two stages with different pulper plate patterns utilized for the initial breakdown and the final fiberizing. Preliminary research for this installation was done by the United States Machinery Co. of New York at the Fiber Products Laboratory in Springfield, Ohio, with Clairefontaine's mill manager, Serge Letellier, present. Mr. Letellier was in the U. S. to determine the most successful equipment and the latest process developments for their new plant.

This French mill will utilize softwood waste materials, to be obtained from neighboring saw mills, and will convert these low cost raw materials into quality mechanical pulp to replace expensive imported groundwood in their production of writing papers. Provision also is being made for bleaching the pulp in the Bauer refiners without the necessity of addi-

tional equipment as heretofore. The importance of this type of installation is becoming increasingly apparent as the Free European Market expands its activities and the necessity for European paper mills to make themselves as self-sufficient as possible as regards pulp supplies becomes a "must."

### Germany

International Paper Co. and the West German corrugated box manufacturing firm of Hch. Sieger K. G. have announced the formation of a new limited liability company with head offices in Cologne. The new company will be known as Hch. Sieger GmbH.

Previously Hch. Sieger K. G. has operated a mill in Zulpich, in the Rhineland, producing corrugating materials and chipboard and corrugated box plants in Hanan and Rodenkirchen. It employs about 1000 men and women.

The new company in which International Paper and Hch, Sieger K. G. will share equal participation will carry on its operations under the management of the West German firm. It is believed that the broad experience of International Paper in the packaging field will contribute to the development of this important industry in Germany.

### Venezuela

International Paper Co. has joined with local interests in the formation of a new corporation in Venezuela, it has been announced by W. S. Snyder, International Paper vice-president.

The new concern, called Envases International S. A., will produce Pure-Pak paper milk containers under license from Ex-Cell-O Corp., Detroit, Mich., for sale within Venezuela.

### Printing Research Conference

Delegates from 15 nations, including Hungary and Russia, will represent their printing ink industries at the Fifth International Conference of Printing Research Institutes June 8–13 at Lehigh University, Albert C. Zettlemoyer, chairman, was announced. The host for the scientific meetings will be the National Printing Ink Research Institute at Lehigh directed by Mr. Zettlemoyer.

Color and printing inks will be the theme of over 40 technical papers to be discussed during the six-day conclave, Miss Jacqueline M. Fetsko, NPIRI supervisor of printing research, program chairman, has announced.

The keynote address will be delivered by Norman S. Cassel, vice-president, research and development, Interchemical Corp., New York, N. Y. His subject will be "Printing Ink Technology in the Space Age."

Two open sessions will be devoted to a discussion of ink behavior in relation to color, transfer, rheology, and fundamental aspects or printability. Directors of foreign institutes will serve as chairmen of these sessions.

Round-table sessions will include discussion of recent developments and trends in color measuring instruments, ink colorants, color separation and correction, control of ink film thickness on presses, problems of newspaper printing, and problems of research personnel and management.

Nations to be represented, in addition to the United States, are Australia, Canada, Denmark, England, Finland, France, Germany, Holland, Hungary, Italy, Japan, Sweden, Russia, and Ukrainia.

In addition to the sessions to be held on the Lehigh University campus, where NPIRI maintains its research headquarters, delegates will make tours of *The New York Times* plant in New York, N. Y., the American Newspaper Publishers Association Research Laboratories, and the Mack Printing Co. at Easton, and the local Bethlehem Steel Co. plant.

The host institute, NPIRI, was established in 1946 a Lehigh University as part of the university's Institute of Research. It was founded to engage in scientific research on printing inks, on the equipment and techniques involved in their production, and on the printing surfaced to which they are applied. Harvey A. Neville, provost and vice-president of the university, also serves as director of the Institute of Research.

### E. W. Clem

Resignation of Everett W. Clem, vice-president in charge of engineering of the Rice Barton Corp., Worcester, Mass., has been announced by Charles S. Barton, president of the corporation. Mr. Clem has been with the company for 33 years, starting in the drawing room and advancing through engineering and sales to his present position.

He was a director of the corporation, and a member of the executive committee. For the past 22 years, Mr. Clem has been responsible for the design of Rice Barton equipment. He holds numerous patents which are assigned to the company and regularly used on Rice Barton equipment.

***E. W. Clem, Rice Barton Corp.***

Mr. Clem is active in the Machine Design Committee of the ASME on which he has already served 12 years. For three years, he also served on the Constitution and By-Laws Committee. For TAPPI, he has served on the Drying Committee and Electrical Engineering Committee. He contributed a chapter to the book, "Manufacture of Pulp and Paper" and assisted in the re-write of "Modern Pulp and Paper Machinery." As a registered professional engineer, Mr. Clem served as the first chairman of the Massachusetts Society of Professional Engineers, Worcester Chapter.

Mr. Clem will be retained by the Rice Barton Corp. as a consultant, and resides at 1 Arnold Road, Shrewsbury, Mass.

### R. H. Stevens

R. H. Stevens has announced his retirement from Herty Foundation effective July 1st. His mail address thereafter will be P. O. Box 211,, Ridgecrest, N. C. Telephone connections will be installed at his home there as soon as possible.

For the past four years Mr. Stevens has served Herty and a few other clients as consultant. He hopes to continue such activities as circumstances may permit. His 42 years in the pulp and paper industry have embraced a wide field including coarse and fine papers, tall oil, size manufacture and consulting laboratory work on paper mill problems.

### Godlove Award

For outstanding contributions to the knowledge of color in science, art, and industry, Ralph M. Evans, director, Color Technology Division, Eastman Kodak Co., Rochester, N. Y., has been selected to be the second recipient of the Godlove Award of the Inter-Society Color Council.

The presentation of the award was made by Walter C. Granville, president of the Inter-Society Color Council, at the banquet held during the 28th Annual Meeting of the Council, at the banquet held during the 28th Annual Meeting of the Council in New York at the Statler Hilton Hotel April 1, 1959. The award is highly unusual in form, consisting of a plastic prism in which is embedded a gold dif-

fraction grating which produces all the colors of the spectrum. The words "Art, Science, and Industry" are engraved on the face of the award. In the center on one side appear the words "The Godlove Award for Contributions to the Knowledge of Color." On the other side appears the name of the recipient, the date of the award, and the name "Inter-Society Color Council."

### Fellowship

Scott Paper Co. has decided to establish a post-graduate research position at the Institute of Paper Chemistry, Appleton, Wis. The objective of the research shall be to increase the basic knowledge of fibrous structures of which paper is one of the most important examples. No immediate commercial goals are part of the program but Scott is convinced that the knowledge obtained will be of value to industry.

The work will be under the direct supervision of the staff of The Institute of Paper Chemistry with active collaboration of the Chemical Research Department of Scott Paper Co. and the person receiving the appointment will be a member of that department. It is hoped that he will join the staff of the Scott Research Laboratory at Chester, Pa., when the assignment at the Institute is completed. There is, however, no obligation to do so. The salary will be in line with that paid for similar qualifications in industrial research.

The Chemical Research Department of Scott Paper Co., comprising approximately 90 people at the present time, is one of the fastest growing and most progressive of industrial research organizations. In addition to extensive work in pulp and paper technology, it is engaged in the development of foamed polymers and of plastic films and coatings. Plans have been approved for the construction of a new Scott research center and office building near the Philadelphia International Airport with total expenditure of about $10 million.

Candidates for this position should have a thorough foundation in physical chemistry including a knowledge of such topics as bonding forces between atoms and molecules, structure of polymeric materials, surface chemistry, and the use of radiation methods for examination of materials. Natural cellulose fibers are the most important source of papermaking material and hence some knowledge of cellulose chemistry would be useful but Scott does not consider such experience as a requirement. Rather, Scott places the most emphasis upon ability to reason creatively, upon training in modern concepts of physics and chemistry, and upon desire to do pioneering research. The degree of Doctor of Philosophy is advantageous for this work, but the appointment is not limited to holders of this degree provided that other factors are favorable. Likewise, no age limit is specified. The person appointed to the position will not be required to do academic or teaching work.

Inquiries should be addressed to Kenneth W. Britt, Associate Director, Chemical Research, Scott Paper Co., Chester, Pa.

### Process Dynamics Conference

The National Science Foundation has announced a grant of $20,000 to Case Institute of Technology, Cleveland, Ohio, to support an experimental summer conference which will expose 30 professors of chemical engineering to the theory and techniques of process control dynamics.

The need for the forthcoming summer conference was conceived of by the Foundation for Instrumentation Education and Research (FIER) and the Process Control Subcommittee of the American Institute of Chemical Engineers (AIChE). In 1958 FIER successfully encouraged National Science Foundation to support a three-weeks course at Case Institute which would introduce teachers of general engineering from technical institutes to similar material. The success of this course promoted FIER to join with AIChE in sponsoring a similar activity in 1959 in the specific field of college-level chemical engineering education.

Case Institute of Technology has built-up an outstanding reputation as an academic leader in dynamic analysis techniques and methodology in the analysis and control of processes. The forthcoming conference of three weeks (July 6–24, 1959) will be under the direction of Donald P. Eckman and Irving Lefkowitz; both internationally known for advanced work in this area. It will consist of an intensive short course composed of lectures, laboratory experiments and discussion periods devoted to the development of control theory and mathematical background for dynamic analysis.

Applicants to the FIER-AIChE sponsored summer conference can come from any AIChE accredited college or university now offering an undergraduate program of instruction in chemical engineering. The 30 most-qualified candidates will receive free tuition to the conference, allowance for travel, and stipends of up to $15 per day. Interested professors or instructors are asked to contact FIER, 335 East 45th St., New York for application forms.

### Cellophane

Cellophane sales climbed to new peaks during 1958 and use of the transparent film was at the highest level in its 35-year history despite the recession and growing competition.

Total sales during the year were 403 million pounds. Usage was estimated to be considerably higher—415 million pounds—with the difference coming from users' inventories. This increase was near the annual 4% rate that in recent years has become the pattern of growth in cellophane use.

Production of the film has doubled since 1948 when the postwar surge to modern packaging and selling methods first took it over the 200-million-pound mark.

The 1958 record was set despite a slow start which saw first-quarter sales off as users reduced inventories in face of generally slow business conditions. Demand picked up in the second quarter and was brisk during the final half of the year.

The gains were also scored in face of the continuing emergence of a number of other transparent packaging materials, some of which offer a price-per-pound advantage over cellophane.

Cellophane's strength during the year resulted from the generally healthy state of the food business, which uses 80% of the domestic cellophane tonnage, and to increased penetration in important segments of that industry.

Bakers are the largest users of cellophane and cellophane sales to them increased 12% during 1958. Film producers attributed much of the increase to the growing trend toward cellophane packaging of white bread. More than one third of all white bread is now packaged in cellophane, they point out, citing a steady growth in this direction that became significant in 1953. Virtually all specialty breads are wrapped in cellophane.

Other industries in which cellophane sales increased during the year to an all-time high included candy, up 4%; biscuits and crackers, up 3%; meat, up 3%; and potato chips, up 10%. Slight declines were recorced in poundage sold for industrial uses (tapes, for example) and for export.

Most significant market development during 1958 was the spurting growth of polymer-coated films. With properties superior to those of nitrocellulose-coated films, these cellophanes were offered as early as 1949 but got major attention for the first time in 1958. Several new types were introduced and their advantages demonstrated through vigorous development work. Although they still constitute a small percentage of over-all sales, their 1958 volume was more than 175% of the 1957 figure.

Since polymer-coated films sell at 17¢ a pound over conventional types, producers interpret their acceptance as a continuing trend toward the evaluation of packaging ma-

terials on ultimate performance rather than price-per-pound alone.

Several new types of cellophane were introduced during 1958 in a continuation of the research and development work that has kept the 35-year-old film abreast of a changing packaging market. Improved versions of the special film that made self-service meat marketing possible were announced, as were more effective cellophane for produce, certain bakery items, and other products with specialized requirements.

Cellophane is manufactured in the United States by American Viscose Corp., E. I. du Pont de Nemours and Co., Inc., and Olin-Mathieson Chemical Corp.

New productive capacity approximating 100 million pounds annually was added during the year, eliminating the threat of shortage which periodically plagued the industry during the decade following World War II.

### Business Forms

Sales of business forms in 1958 rose to a conservatively estimated $350,000,000, which equal those of 1957, a record year for dollar volume by the industry, according to an announcement made by the Business Forms Institute at its annual members' meeting held February 19–20 at the Park Lane Hotel, New York.

Dollar volume of forms sold climbed in the past two years $42,000,000 for each year over 1956, with every indication that 1959 will exceed the 1957 and 1958 totals, although the increase is expected to be steady rather than spectacular. Member companies of the BFI, generally regarded as authoritative barometers of general business conditions, are situated from coast to coast.

W. C. Lamprechter, vice-president and general manager, Stephen Greene Co., Philadelphia, was reelected president of the institute. Lester J. Johnsen, executive vice-president, Atlantic Register Co., Waltham, Mass., was elected first vice-president, succeeding T. S. Duncanson, president of Moore Business Forms, Inc., Niagara Falls, N. Y. Messrs. Lamprechter, Johnsen and Duncanson comprise the 1959 executive committee of the BFI.

Thomas A. Taylor, vice-president, Schwabacher-Frey Co., San Francisco, was renamed second vice-president, and H. M. Meloney, of the main BFI office at Greenwich, Conn., continues as executive director.

### Envelopes

Nobody has figured out how much extra time and money it costs post offices all over the world to handle envelopes of all sizes and shapes, ranging from the no. 10 envelope ($9^1/_2$ by $4^1/_4$ in.) favored by American business to the compact 4 by 5-in. envelope popular in England. Varying envelope and postcard sizes are also a great obstacle in the automatic canceling of stamps and sorting of mail.

However, a solution is in sight. An international project is underway to standardize paper and paper products, including envelopes and postcards.

American groups, which had not participated in this international work, have now expressed an interest in the project. This was reported at the February 10 meeting of the American Standards Association Sectional Committee X2—Office Standards—in New York.

An advisory committee, now being formed, was scheduled to meet in New York on February 26 to discuss the possibility of American participation in the work of Technical Committee 6—Paper—of the International Organization for Standardization (ISO). The American Standards Association is the United States member of ISO.

Among the groups to be represented on the advisory committee are the Technical Association of the Pulp and Paper Industry, the American Paper and Pulp Association and Committee D6—Paper and Paper Products—of the American Society for Testing Materials.

ISO Technical Committee 6 is concerned with terminology dimensions and methods of tests for paper; weights of paper in sheets, reams, and rolls; method of expressing dimensions of paper according to grain structure; postal envelopes; format of messages on illustrated postcards; the standardization of punched holes in paper; and specifications for packing paper and cartons.

Spokesmen of TAPPI and ASTM have already made unqualified recommendations for American participation in the project. The APPA has expressed an interest in international terminology for paper and paper products. Sectional Committee X2, at their meeting on February 10, declared this interest and appointed as their spokesman, Frank M. Knox, president of the management consultant firm of the same name.

American participation in international standards work is arranged through the American Standards Association, the national clearinghouse for standardization in the United States.

### Wire Weavers Association Agreement

A five-year labor agreement was signed last month between management of the Eastwood Neally Co. and the American Wire Weavers Protective Association, UPP, AFL-CIO.

The contract, covering men who weave paper machine wire cloth at the Belleville, N. J. plant, "will guarantee stabilized production of high qualtiy wire at competitive prices," according to President George Wilson of the Wire Weavers Union.

Last month the Wire Weavers Association ended 65 years as a national affiliate of AFL-CIO to merge with the United Papermakers and Paperworkers. The action followed unanimous agreement of the AWWPA and UPP executive boards, later ratified by vote of AFL-CIO's Executive Council at its winter meeting.

Wilson said, the Eastwood Neally settlement was the first five-year agreement in the history of the union. He added, the union would seek similar settlements with other firms weaving paper machine wire cloth.

### Supercalendered Newsprint

Four Appleton, Wis. firms have put their corporate heads together in an attempt to improve the quality of standard newsprint by supercalendering.

Appleton Machine Co. approached the *Appleton Post-Crescent* with the idea of supercalendering newsprint. Appleton Machine officials felt supercalendering would smooth out the "fuzz" and reduce the blotter effect on inks.

An experiment was set up using Appleton Post-Crescent newsprint rolls and supercalender stacks located at Fox River Paper Co. and Appleton Coated Paper Co. Appleton Machine's interest in the project was consistent with its being the largest manufacturer of supercalenders in the country (approximately 70% of all those built in the United States).

After the newsprint had been supercalendered it was fed into a regular daily press run at the *Post-Crescent*. No changes or adjustments were made in normal printing procedures.

The same ink, press speeds, and basis weight sheets were used. The run became the outside page for each section of the day's paper including the front page.

The results of the experiment proved very promising. In addition to an obvious visual reproduction improvement, the following technical results were recorded from laboratory tests:

Approximately 20% increase in smoothness (Williams).
Increased Mullen or burst strength.
Corresponding increase of density to decrease in caliper.
Improved dry tensile in machine direction.

Other important improvements noted by printers and publishers were:

Better uniformity of ink distribution on halftones.
Indications that finer screenings can be used for sharper photos.
Considerably less fiber "fuzz" to contaminate inks.
No hourly production slow down required.
Sharper clarity with less ink indicated.

Additional laboratory tests are being conducted to determine the full benefits possible to newsprint users. By supercalendering newsprint it is hoped the cost of manufacturing the paper can be reduced, report Appleton Machine officials.

According to the *Appleton Post-Crescent*, "—the quality of photographic reproduction inproved so graphically that it approached the lithographic or rotogravure process."

### Kappa Number

The Executive Committee of ICCA (the International Committee for Cellulose Analysis) has approved the analytical method "Kappa Number of Pulp" by a vote of 11 to 0 and recommends it for international adoption. This is the first method approved by ICCA, and it has been given the number ICCA 1:59.

The executive members representing the following countries had no objections to the international adoption of the method:

| | |
|---|---|
| Canada | Italy |
| Czecho-Slovakia | Norway |
| East Germany(DDR) | Sweden |
| Finland | Switzerland |
| France | West Germany |
| Great Britain | |

Due to the procedures followed for final adoption of a standard in the United States and Australia, no formal approval has, as yet, been obtained; however, the Chemical Methods Committee of TAPPI has approved the method and has started it through the channels necessary for formal approval.

The need has long been felt for a standard method for the determination of the degree of delignification of all kinds of pulp. The Kappa number method covers the entire range of pulps up to semichemical unbleached wood pulps obtained in less than 70% yield. The Kappa number is defined as the number of milliliters of tenth normal potassium permanganate solution consumed by one gram of pulp. The determination is made in such a way that the results can be corrected to 50% permanganate consumption. It is thus possible to grade all pulps on the same scale. This has not been possible with most permanganate number methods published.

It is hoped that the method will prove useful in both scientific and routine work. The determination is quickly and easily made and the reproducibility is claimed to be very good. A standard method allowing "hardness" figures to be comparted internationally should be useful in trade, as well as in scientific publications.

The method is based on publications by Tasman and Berzins (*Tappi* 40: 691), Valeur and Törngren (*Sv. Papperstidn.* 60: 829), Watson and Stamp (*APPITA* 2: 4, 1957) and others. The details have been worked out by the ICCA subcommittee on permanganate number, whose members were: L. C. Aldrich (U.S.A.), P. O. Bethge (Sweden), H. Sihtola (Finland), J. Tasman (Canada), C. Valeur (Sweden), and A. J. Watson (Australia).

### Newsprint Committee

An unprecedented effort by leading suppliers of newsprint to strengthen through new research the competitive position of the United States newspapers was announed by the Newsprint Information Committee today.

The Newsprint Information Committee revealed that the committee has volunteered to underwrite, and that the Bureau of Advertising, ANPA, has agreed to counsel and advise on, a major research project to explore a new measure of newspaper advertising effectiveness.

The committee is composed of a representative group of Canadian newsprint producers: Abitibi Power & Paper Co., Ltd.; Anglo-Canadian Pulp and Paper Mills, Ltd.; Anglo-Newfoundland Development Corp., Canada Paper Co.; Donnacona Paper Co., Ltd.; Powell River Co., Ltd.; and St. Lawrence Corp., Ltd.

Douglas W. Ambridge, chairman of the Newsprint Information Committee, asserted that "the newsprint producers making up the committee believe it is in the interest of their industry to work closely with their prime customer in maintaining and bettering the competitive position of newspapers as a medium.

"Accordingly, we are demonstrating that belief through this project to explore scientifically, through independent research, a new dimension of the impact of newspaper advertising upon consumers.

"In addition to their vital civic role, newspapers have consistently met the challenge of competing media. Research such as that being undertaken will benefit newspapers, suppliers and advertisers alike by providing important clues on the best use of newspapers as a medium for maximum results."

It is expected that the study will be conducted by one or more leading universities in the United States Procedures and techniques to be employed in the research will be submitted for review by the Advertising Research Foundation.

Louis A. Weil, Jr., chairman of the board of directors of the Bureau of Advertising, ANPA, and Publisher of the Lafayette, Ind., *Journal* and *Courier*, stated:

"Results of this major research project, which the Newsprint Information Committee on its own initiative has selected, and which will be paid for by the committee and conducted by independent authorities, should help guide advertisers in investing a larger share of their advertising dollars in newspapers.

"The board of directors of the Bureau of Advertising, at its meeting in Chicago on January 23, passed unanimously a resolution expressing its appreciation to the Newsprint Information Committee for volunteering to conduct this research project.

"The Bureau is always glad to counsel with anyone interested in promoting greater use of newspaper advertising."

### Sulphur

Total production of sulphur from all sources in the United States during 1958 amounted to approximately 6,200,000 long tons, compared with 7,000,000 tons in the previous year. Mexican sulphur production increased during 1958, and currently accounts for some 20% of Frasch sulphur production on the North American continent.

Total Free World shipments of sulphur in all forms during 1958 were approximately 15,300,000 tons, a decline of 4% from the 16,000,000 tons shipped in 1957. About half of this world total was elemental sulphur (Frasch, surface-mined, and recovered) and the remainder consisted of sulphur equivalent obtained from pyrites and other metallic sulphides, sulphates, and spent oxides.

Shipments of Frasch sulphur by U. S. producers dropped some 8%, or 400,000 tons, below the 5,000,000 tons shipped in 1957. A factor affecting this decline was an increase in shipments by Mexican producers of 190,000 tons, plus a gain of 90,000 tons in recovered sulphur.

The decline in sulphur shipments, both in the U. S. and the world markets, resulted from the nearly simultaneous interaction of oversupply, the 1957–58 recession, plus the cumulative impact of new sulphur sources.

—From *Annual Report 1958*, Texas Gulf Sulphur Co.

### Kimberly-Clark

Less pounds of spent-sulphite solids will hereafter go into the Fox River from its Kimberly, Wis. mill and correspondingly more pounds of this material can be used for roadbinder, Kimberly-Clark Corp. announced February 5.

The company reported to the State Committee on Water Pollution that a large-scale construction job, newly completed at the mill's roadbinder storage area, will permit stepping up the company's stream-improvement program still further in 1959. Plans for this abatement project were submitted to the State of Wisconsin early last September and construction was started immediately.

In April, 1957, Kimberly-Clark agreed to maintain a sulphite abatement of 60% at all times (based on the state's 1948 stream survey figures) and of 70% for the seven hot-weather, low-flow months. The mill reached and held this goal throughout 1958 for the first full calendar year, a new high standard here and one of the highest ever attained in the sulphite pulp industry.

The current report to state officials outlines specific steps the company has taken in recent months with the goal of reaching still higher levels. The mill now has installed new pumps, weirs, dikes, and canals in its storage-pond area where it accumulates during off seasons enough sulphite liquor to fill roadbinder orders that exceed current production during the roadwork months.

Using the new equipment, it now becomes possible to load roadbinder trucks at all times with the strongest stored liquor while discarding liquor weakened by rain, snow, or winter stratification. Thus, greater tonnages of oxygen-consuming sulphite solids will go into road surfaces instead of the river.

The precise degree of stream improvement attainable from the newly added abatement facilities depends to some extent upon the quantity of roadbinder that highway officials order. Company spokesmen are therefore unable to forecast exact percentages to be reached, but the figures will be substantial.

### Consolidated Water Power

The Appleton mill of Consolidated Water Power & Paper Co. will step up by 47% its capacity for burning spent sulphite liquor which previously was discarded into the Fox River with construction of new boiler-house early this spring.

Plans for the million dollar project were announced February 5 by Henry P. Baldwin, vice-president—manufacturing. Construction schedules call for completing the installation in time for full-scale operation of the new plant by next winter.

A new steel and metal building will be erected to house two new boilers that will replace six smaller capacity units which have been in use for many years. One new boiler is designed to burn oil and 20,000 lb. of 55% concentrated spent sulphite liquor per hour while the other will burn oil and bark. Capacity of the present plant for burning sulphite liquor of this concentration is 13,600 lb. per hour. Oil was selected as a basic fuel for the new boilers because of greater ease in controlling the mixed firing of oil and concentrated liquor and because of lower operating cost.

Consolidated was one of the pioneers in evaporating spent sulphite liquor to 57% solids content and burning the concentrate for industrial fuel. An evaporator plant was installed at the Interlake mill in 1953 and has substantially reduced the mill's discharge of oxygen demand to the Fox River. The new burning equipment is designed to make this stream improvement program still more effective.

Two personnel appointments in the Engineering Department of Consolidated Water Power & Paper Co. have been announced by M. V. Molsberry, chief engineer.

Richard Stoughton has joined the instrumentation, steam, and combustion section of the department as an instrumentation engineer. Mr. Stoughton, who was graduated from Tri-State College, Angola, Ind. with a B.S. degree in mechanical engineering, has been employed by the Bailey Meter Co.

Charles P. Thomas joined the department as a mechanical engineer. Mr. Thomas was graduated from the University of Wisconsin with a B.S. degree in mechanical engineering last month. He is a native of Watertown, Wis.

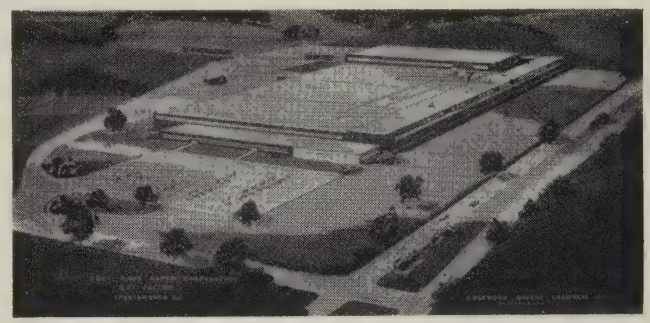
### Union Bag

Union Bag-Camp Paper Corp., one of the oldest and best known companies in the nation's pulp and paper industry, has completed plans for the construction of a modern corrugated box plant in the Spartanburg, S. C. area, which will give employment to 120 people.

The announcement of the company's intention to locate a converting plant there was made by Alexander Calder, Jr., company president, who stated that the new plant would be located on a 25-acre tract.

The building will be of brick and steel construction with an area of 136,000 sq. ft. The construction contract will be let immediately, Mr. Calder stated, and the plant is expected to go into production in December, 1959.

Contract for the engineering on the building was recently awarded Lockwood-Greene Engineering Co. of Spartanburg, and Mr. Calder stated that the corrugator and other equipment used in the manufacture of corrugated shipping containers will be erected and laid out by the company's engineering division, under the supervision of Robert T. Inman, chief construction engineer.



***New corrugated box plant of the Union Bag-Camp Paper Corp. located near Spartansburg, S. C.***

The site of the new plant is a tract located on Highway 29-A, between Spartenburg and Greenville, and adjacent to the intersection on Interstate Highway 85. The plant will be served by the Southern Railway and its location is readily accessible to several major highways.

Practically all of the approximately 120 persons employed in the operation of the plant will be recruited from the Spartanburg area, Mr. Calder pointed out.

The plant will better serve the textile industry and other types of industry in the rapidly expanding Piedmont area in the Carolinas, and the building is designed to allow for future expansion.

The kraft paperboard which will be converted into all types of corrugated boxes at the Spartanburg plant will be furnished by the Savannah plant of Union Bag-Camp Paper Corp., which is recognized as the largest pulp and paper mill and kraft container plant in the World.

In commenting on the company's decision to locate a manufacturing plant in South Caroline, Mr. Calder said:

"We have always felt very close to South Carolina. For a number of years the company has owned forest acreage in the state, and over a period of 20 years has purchased millions of dollars of pulpwood from private land owners in the state. We have great confidence in the future of the Spartanburg area, and are impressed with its potential for industrial expansion."

### ANPA Open House

Twenty-five newsprint industry representatives attended a laboratory open house sponsored by the ANPA Research Institute on February 27 following the 44th TAPPI Annual Meeting in New York.

Primarily interested in the research institute's newsprint quality program, the visitors first saw typical newsprint samples being run through 17 paper tests plus the Larocque printing quality test on which the project is based. The samples were the latest of over 600 collected from newsprint rolls as they were run in press rooms all over the country. In this way, the products of 54 of the 56 North American newsprint mills are being tested. The sampling kit was also demonstrated showing how the newspaper pressman takes the newsprint sheets from near the roll core and seals them in an airtight mailer. This assures the newsprint is received by the lab in "as run" condition.

After luncheon, the statistical treatment of the test data was illustrated with scatter diagrams showing attempts to correlate the readings from each of the paper tests with the results of the printing quality test. George Sears of The Institute of Paper Chemistry and Roy Prince, ANPA-RI's director of technical research, presented the conclusions arrived at so far from the project.

Briefly, it has been found that about half of the variation in newsprint printing quality is due to the individual variations of brightness, smoothness, and hardness. In other words, if these three physical factors could be kept constant in newsprint, 50% of the fluctuations in printing quality would be eliminated.

The rest of the afternoon was taken up with a tour of the lab's newspaper production and research facilities. The group saw projects in progress on the full-size press and folder, the stereotype molding and casting equipment, and the experimental web fed offset newspaper press.

### Marathon Southern

Construction of a third paper machine facility will start in May at the recently completed pulp and paper mill at Naheola, Ala., of the Marathon Southern Corp., operating subsidiary of Marathon—A Division of American Can Co., Menasha, Wis. The design and construction for this expansion program will be performed by the Rust Engineering Co. of Pittsburgh, Pa., and Birmingham, Ala.

The new Marathon Southern Corp. paper machine, to be completed early in 1960, will produce a wide range of paperboard for food packaging materials and similar products.

### Oxford

Harry J. Buncke, vice-president—engineering, Oxford Paper Co. at Rumford, Me., was transferred to the company's executive offices in New York effective Feb. 1, 1959, it was announced.

This relocation of the company's top engineering officer is occasioned by the extensive kraft construction program which makes desirable a closer correlation of his responsibilities with other top management functions.

*H. J. Buncke, Oxford Paper Co.*

### Crown Zellerbach

Crown Zellerbach Corp. has announced that it had completed its investigation into the possibility of establishing pulp and paper operations in the Province of Newfoundland. The company stated that as a result of the economic factors disclosed by intensive on-the-spot surveys it would not be able to proceed with a manufacturing program in the province.

The company expressed its conclusions in a message to Premier Joseph Smallwood of Newfoundland.

"In accord with our agreement," the company advised Premier Smallwood, "we have intensively studied the possibilities of establishing newsprint operations on the island of Newfoundland. We have also studied the possibility of establishing an unbleached kraft pulp mill on the island based upon Labrador wood. We put investigating parties into both the island and Labrador, and studied existing operations as well as possible new operations.

"These studies," the company stated, "included possible mill sites, water and power, transportation, labor availability, wood availability, and estimates of the costs of the many factors entering into newsprint and kraft pulp production. We have concluded that operations which we would undertake carry costs which, with today's selling price for newsprint, make it impossible for us to invest the capital required for a new newsprint mill. It is also clear that economic factors rule out the investment required for a kraft mill based upon Labrador wood.

"It may develop that cost-price relationships will change so that conditions for new newsprint or kraft investments will be more favorable. Based upon today's economy, however, we have no real choice but to state that we cannot go forward."

Some 18,000 printers and publishers recently received a unique newsletter which posed the question, "What is Level/Smooth?" Crown Zellerbach's answer, soon to be actually demonstrated to printers at their offices and plants, translates "Level/Smooth" into "premium printability at non-premium prices."

The ingenious "Level/Smooth" demonstration kits are part of the introductory program which will launch Crown Zellerbach's new roll and trailing-blade coated printing papers in the market.

Manufactured at a recently completed modern mill at St. Francisville, La., Crown Zellerbach's double-coated book papers are produced on the "Delta King," a 500 ft.-long machine combining the advantages of the roll coater and the leveling action of the trailing-blade coater in one continuous, on-machine operation.

### Western-Waxide

The Western-Waxide Division of Crown-Zellerbach Corp., San Leandro, Calif., has installed a complete Egan polyethylene coating machine for the production of packaging papers.

The new high-speed unit was designed and constructed by Frank W. Egan & Co. of Somerville, N. J.

Equipped with Egan's latest flying transfer two-spindle turret winder with both constant and taper tension, as well as a turret unwind, the machine is capable of speeds up to 1000 f.p.m. It will handle lightweight papers, foil and cellophane and other films at web widths up to 54 in.

The $4^1/_2$-in. extruder is mounted on a retractable carriage. The extruder hopper can be loaded from floor level with an IMS Dracco hopper loader.

Another special feature of the installation is that all wiring and piping have been concealed in floor trenches for maximum neatness and safety.

### I. P.

Arthur F. Perkins has been named Manager of International Paper Co.'s Mobile, Ala. mill. it has been announced by C. L. Crain, vice-president and manager of manufacture.

Mr. Perkins replaces J. A. Lyden, mill manager since 1955, who is now on special assignment in the division manufacturing office.

Mr. Perkins is a graduate electrical engineer of the Georgia Institute of Technology. He joined International Paper Co. in 1935, beginning his career at the company's Panama City, Fla., mill.

### Continental Can

The Daniel Construction Co. of Greenville, S. C., has been awarded the general contract for construction of Continental Can Co.'s bleached board mill at Augusta, Ga., it was announced by C. B. Stauffacher, executive vice-president of Continental's Robert Gair Paper Products Group.

Construction was scheduled to start on March 15, with operations set for the last quarter of 1960. The mill will produce 350 tons per day of bleached paper and board for use in packaging food products. The initial 350-ton capacity will be provided by a 216-in. trim fourdrinier paper machine.

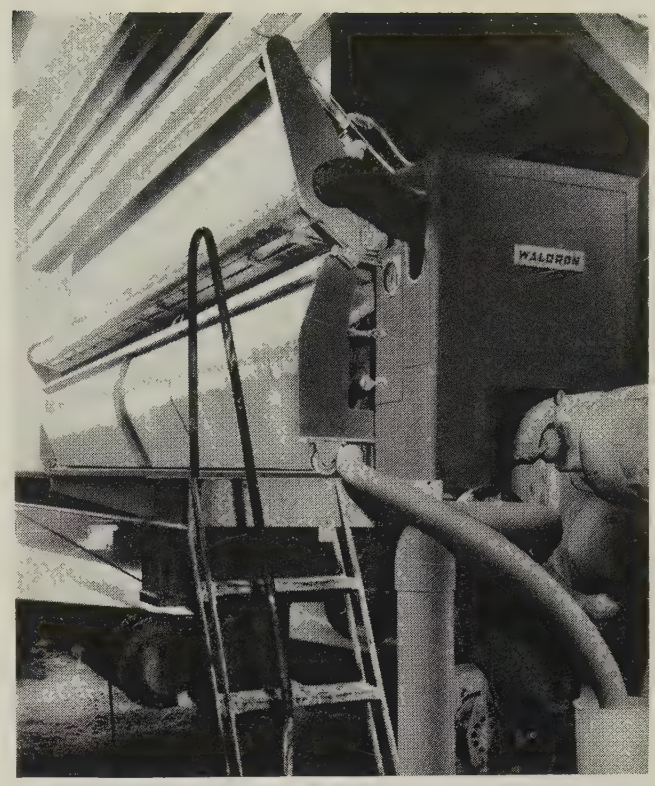
Designed for step-by-step expansion, the mill is to be located on a 2600-acre site, on the main line of the Georgia Central Railroad, 11 miles south of Augusta.

### Riegel

When installing its new 236-in. paperboard machine, the Carolina Belle, at its Carolina Division, Riegelwood, N. C., the Riegel Paper Corp. provided for on machine coating to avoid the extra costs involved in transporting paperboard to, and processing it on, independent coating equipment. The coater, one of the largest air-jet coaters yet installed, was included in spite of the fact that not all paper and board produced on the new machine is coated. Coating equipment is arranged so that the web can by-pass it when coating is not required.

The coater applies clay coating to one side of 10 to 27-point board stock with coating weights ranging from 6 to 9 lb. per 3000 sq. ft. at speeds from 300 to 600 f.p.m. Preferred coating compositions have a solids content of 30 to 45%.

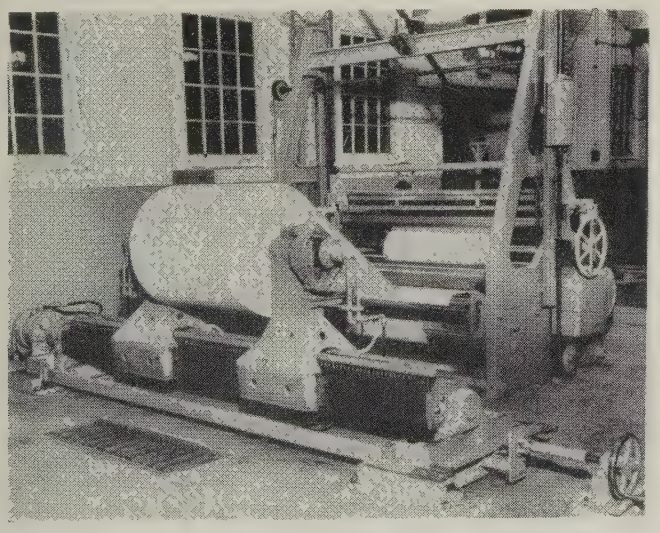
The coater was manufactured by the John Waldron Corp., New Brunswick, N. J., and utilizes the Waldron Microjet method of coating. A slight excess of coating is applied to the web with a coating roll and this excess is removed by a high velocity air jet from a precision nozzle which is approximately




*John Waldron Midrojet coater on the Carolina Belle*

equal in length to the width of the widest web which can be run on the machine. The coating weight is regulated by the velocity of the air jet striking the web.

Prior to applying the clay coating, Riegel treats the web at the first calender stack. The web then travels under the coater, passes over two drier rollers, and doubles back into the coater. The coating roll runs partly immersed in the coating solution, picks up coating from the application pan and deposits it on the web as the web passes over it. The web then passes vertically upward over a backing roll and a jet of air removes the excess coating as the web travels over this roll. This excess coating drains into a pan for return to the process.



***Shown here is the Cameron model SMP-42 shaftless unwind built by Cameron Machine Co., Dover, N. J., and installed at Finch-Pruyn Co., Glens Falls, N. Y. The new shaftless pick-up unwind equipment makes it possible for one man to load heavy parent rolls. The unit is hydraulically operated and can accommodate rolls ranging in diameter from a minimum of 17 in. to a maximum of 42 in. and from 12 to 100 in. wide. It has two water cooled, continuous duty unwind brakes providing extreme range of torque control***

### Ontario-Minnesota

Operating economies and improved working conditions will result from extensive improvements in the old grinder room of the Kenora mill. The project, under way since early spring, is now virtually complete.

Major phases of the modernization program included new heating and ventilating facilities, replacement of the hydraulic system for the Waterous grinders and installation of electrical load control equipment. Miscellaneous improvements in the over-all program include a modern lighting system and a complete paint job.

New fresh air supply fans, exhaust fans, filters, supplementary heaters, and hundreds of feet of ductwork make up the modernized heating and ventilating system. The equipment provides forced ventilation of the seven grinder motors ranging in capacity from 2800 to 3200 hp. Warm air exhausted from the shrouded motors is used to heat the building, and the motors operate more efficiently at the lower temperatures.

Another feature of the installation is an effective vapor exchange system which draws moisture from the grinder magazines and bull screen areas and exhausts it into the atmosphere instead of to the grinder room and charging floor.

In addition to providing more efficient utilization of heat, the improvements will extend the life of equipment by helping eliminate rust-causing condensation.

Contributing to better working conditions, the system will

permit more uniform temperatures and humidity control. The motor enclosures will reduce noise.

The hydraulic control system for the Waterous grinders was completely replaced with new and improved equipment designed for faster valve operation and reduced maintenance.

The original four-way plug valves with ratchet mechanism were replaced with four-way Saunders type diaphragm valves supplied by the Meyer Governor Co. These valves, hydraulically operated, control the hydraulic pressure to the rams which force the pulpwood against the grinder stones. Sixteen valve assemblies were installed, one for each pocket of the eight Waterous grinder units.

—From *The Mandonian*, September–November, 1958.

ST. REGIS

St. Regis Paper Co. has filed with the Securities and Exchange Commission a registration statement relative to the issuance of shares of St. Regis common stock to be offered in exchange for the 90,000 outstanding shares of common stock of Cupples-Hesse Corp. of St. Louis, Mo.

The proposed offer would provide that if the exchange offer is declared effective, a total of not exceeding 58,000 shares of St. Regis common stock would be issued on the basis of six hundred forty-four thousandths (0.644) of a share of St. Regis stock for each share of Cupples common stock.

Cupples has two subsidiaries: Cupples-Hesse Corp. of Iowa, and Cupples-Hesse Corp. of Michigan. Cupples and its subsidiaries produce a full line of envelopes and Cupples itself also produces shipping and merchandise tags. These products are sold directly to consumers in a territory extending throughout the central portion of the United States as far west as Denver, Colo., and as far east as Cleveland, Ohio. The three Cupples plants are located at St. Louis and at Des Moines, Iowa, and Detroit, Mich. Sales of Cupples in 1958 were in the neighborhood of $7 million.

St. Regis Paper Co. announces the appointment of Gordon C. Inskeep as administrative assistant to Kenneth A. Arnold, technical director of the company.

Before joining St. Regis, Mr. Inskeep was assistant to the president of Processes Research, Inc., industrial consultants. From 1950 to 1956 he was associate editor of *Chemical and Engineering News*. He was a production supervisor with Commercial Solvents Corp. from 1944 to 1950.

Mr. Inskeep has a B.Ch.E. degree from Ohio State University and has done graduate work at the Institute of Paper Chemistry. He is a member of the American Chemical Society, American Institute of Chemical Engineers, TAPPI, and Tau Beta Pi. His headquarters will be in the New York Office.

In the Central Technical Customers Section, under the supervision of Gordon L. Benson, the Kraft Paper and Board Technical Service Group is now organized to function with the following personnel;

Milton R. Roberts is the administrator of technical service to customers of the Kraft Division. He is located at the New York office.

John T. Freymeyer is the Kraft Division technical service to customer representative located at Pensacola, Fla.

Robert T. Callahan is the technical service to customer representative servicing the Kraft Division in the Chicago area. He will be located in the Chicago office.

St. Regis Paper Co. has announced the appointment of Frank A. Albert as manager of lands and forests for the company's woodlands in the South. The announcement was made through the office of Albert Ernest, St. Regis vice-president in charge of Southern woodlands, and is part of a reorganization of the company's woodlands organizations reflecting the steady expansion of St. Regis' operations in the South.

Mr. Albert most recently served as director of the Georgia Forest Research Council. He is graduate forester from Penn State University, and retired in 1957 from the United States Forest Service after 30 years of service, principally in the South. Mr. Albert will make his headquarters in Jacksonville, Fla.

*F. A. Albert, St. Regis Paper Co.*

Marcus G. Rawls has been named manager of wood procurement and land acquisition for St. Regis southern woodlands, serving St. Regis mills in Jacksonville and Pensacola, Fla. Mr. Rawls is a graduate of the University of Florida and joined St. Regis in 1948. He has played a leading role in the company's woodlands operations in the South since that date. His headquarters are in Jacksonville.

Joseph M. Brewster has been appointed assistant manager of wood procurement and land acquisition for St. Regis southern woodlands in the Pensacola area. Mr. Brewster joined the company in 1947 and has been serving as woodlands manager at the company's Pensacola mill. He will continue to make his headquarters in Pensacola.

Groundbreaking for a new, larger plant of Dubuque Container Co. Division of St. Regis Paper Co. was scheduled for about May 1, Frank L. Wagner, president and general manager of the Dubuque Division, announced recently.

The plant, to make corrugated containers, will be the first of two new units planned to house Dubuque Container's corrugated containers, folding and setup box manufacturing operations.

The completed project will total 200,000 sq. ft. of manufacturing area located on 14 acres of the City of Dubuque's industrial park development site, formed from dredging and landfill in the Mississippi River bed.

The plant site will include railroad sidings, auto parking, and employee recreation areas.

Mr. Wagner said that design and construction contracts have been awarded to the Miller-Davis Co., Kalamazoo, Mich. The contract calls for completion of the corrugated plant by Nov. 30, 1959. The corrugated plant will consist of about 90,000 sq. ft. in a one story building, the balance for the folding and setup plant, and general offices.

In recognition of the increasing interest and activity in the fields of scientific forestry and forest genetics, as well as its own expansion in the forestry field, St. Regis Paper Co. has made available an additional fellowship in forestry. Now St. Regis offers two fellowships in forestry, valued at $1000 each, and given for one year. St. Regis has awarded one such fellowship annually for the past six years to degree holders planning to take graduate work in any accredited school of forestry in the United States and Canada. Also, for the seventh year, St. Regis offers five undergraduate scholarships in forestry.

Winners of the two St. Regis fellowships in forestry this year are Russell J. Hutnik of State College, Pa., and John P. Vimmerstedt of Asheville, N. C.

Mr. Hutnik holds a Bachelor's degree in forestry from Pennsylvania State University and a Master's degree in forestry from Yale University. At present, Mr. Hutnik is an assistant professor in forestry at the School of Forestry of Pennsylvania State University.

Mr. Vimmerstedt, a native of Jamestown, N. Y., is currently a research forester with the Southeastern Forest Experiment Station at Asheville, N. C. He has a Bachelor's degree in forestry from the New York State School of Forestry at Syracuse, and a Master's degree in Forestry from Yale University.

The committee responsible for making the graduate award

was composed of R. E. McArdle, chief of the U. S. Forest Service; V. L. Harper, chief of research of the U. S. Forest Service; Benton R. Cancell, executive vice-president of St. Regis; and Paul M. Dunn, St. Regis director of forestry.

### Tennessee River

The M. W. Kellogg Co., subsidiary of Pullman Inc., received a lump sum contract for approximately $30 million to engineer and construct a 500-ton kraft pulp and linerboard plant for the Tennessee River Pulp and Paper Co. The plant will be located at Counce, Tenn. on the Tennessee River just south of the Pickwick Dam.

The M. W. Kellogg Co. has entered into a subcontract with H. A. Simons Ltd. of Vancouver to assist in the design of the plant. Initial construction operations have started and the construction schedule calls for completion by Jan. 1, 1961.

The acceptance by Kellogg of complete engineering, procurement, and construction responsibilities for a lump sum figure, although a common practice in the petroleum and chemical industry, is not the general practice for the pulp and paper industry. The normal practice for large construction projects for the paper industry is a fixed engineering fee with open costs for material and field labor. John McAneny, sales manager for Industrial Projects at the M. W. Kellogg Co., said, "Our acceptance of complete technical and financial responsibility for the satisfactory building and completion of this new Tennessee pulp and paper plant is an important service to our client. In effect we have established his capital requirements so that he can plan with complete assurance. From our point of view we are confident that we will be able to deliver a more efficient plant at a lower cost because our engineers will have freedom to design at an optimum capital investment. Furthermore by the fact that we have reached an agreement with our client on the basic designs of the plant prior to commencing detailed engineering, we have reduced the innumerable costly engineering and construction changes that usually occur on open cost projects. In short, there is an incentive for efficiency which will work both to our client's advantage as well as to ours."

### Crossett

The Crossett Co. has purchased all of the assets of Triangle Paper Bag Manufacturing Co. of Covington, Ky., effective April 1, 1959.

P. F. Watzek, president of Crossett, and E. A. Jacobs, president of Triangle, made known the transaction.

There will not be any changes made in the general operating policies or management personnel of either organization, the announcement said. Triangle will operate as Triangle Bag Co., a wholly owned subsidiary of the Crossett Co.

Crossett Paper Mills, a division of the Crossett Co., has always operated as an independent supplier of kraft paper and bleached food board to independent converters and merchants. As such, Crossett has been the principal source of unbleached kraft paper for Triangle.

In a statement to the trade press, Mr. Watzek declared: "This transaction does not indicate any wide departure from Crossett's basic policy of operating as an independent producer of kraft paper and bleached food board. We will continue to meet every commitment to every customer. We do not plan any additional moves into the converting field."

Work has been completed on the installation of a paper coating pilot plant in the Crossett Co.'s research division to provide for the study of various methods of applying coating, such as clay and plastics, to bleached food board and kraft paper.

K. G. Chesley, director of research, said that in addition to providing an opportunity for the development of new and better paper products, which may be manufactured at Crossett, the experimental plant means additional tools to improve the range and quality of Crossett Paper Mills' service to customers, who convert its products into a variety of end use items.

The equipment represents an investment of about $105,000, according to Mr. Chesley.

The plant, designed specifically for Crossett by Dilts Division of the Black-Clawson Co., Fulton, N. Y., has the capacity for running paper or paperboard from 12 to 36 in. wide. The minimum speed is 50 f.p.m. It can be operated as fast as 500 f.p.m. It duplicates all of the problems and opportunities of a full size commercial coater.

According to the research director, clay coatings such as will be tested with the new equipment are applied to paper or paperboard in order to improve printability. Other properties of the products, such as gloss, smoothness, brightness, and feel, may also be improved.

Studies will also be made into functional coatings in the plastic fields. It was explained that interest in these coatings is caused by the increasing demand in the paper converting industry for packaging materials that will provide functional or protective properties as well as eye appeal. For example, in the past five years the consumption of polyethylene film in the field of protective packaging has experienced a growth of over 1000 %. In addition, other new films have been introduced.

"The most logical way to improve paper products is to combine paper and paper board with plastic coatings, films, and additives to make products which are better or less expensive than either paper or plastics alone," Mr. Chesley declared. "We believe that this new equipment is a step in that direction."

The Crossett Co. has announced that it will spend about $800,000 this year on the installation of new equipment to improve the quality of kraft paper produced at Crossett Paper Mills.

This is the second major modernization and expansion project to be announced at the Crossett Co.'s Paper Division within the past four months.

According to J. E. Meadows, assistant manager of Crossett Paper Mills, plans call for the installation of additional pulp screening and refining equipment and a new type of paper drier utilizing high velocity air on one of the kraft paper machines. New facilities for handling wood chips purchased from sawmills will also be included. Specifically, this equipment will provide for the separation of sawmill chips from chips produced at the kraft paper mill from pulpwood.

Engineering has already been started by Rust Engineering Co. of Birmingham, Ala., Mr. Meadows said. Some of the new equipment has been ordered, and work will be started early this summer.

Last November, the Crossett Co. announced that the production capacity of its bleached food board mill would be expanded by one-third with a $3,400,000 building program. It was also reported then that $130,000 would be spent to build a bark storage bin at the company's kraft mill. This latter installation will provide more even and efficient burning of bark and greatly reduce the discharges of cinders that have occurred occasionally at the mill. Work is now underway on these projects.

### Puget Sound

With a 100,000 lb. a day Bowen spray drier now in operation at Puget Sound Pulp & Timber Co., Bellingham, Wash., a new Lignin Products Department has been formed to provide specialized attention and quality control of the products now produced on a larger scale. Lignin by-products now are used primarily in mud drilling, cement, adhesives, vanillin, and plant supplemental nutritives.

The giant Bowen spray drier, which is producing above specification spherical fines, is the central piece of equipment in a $400,000 expansion program recently completed at Puget Sound Pulp & Timber Co. The drier went onstream this

month, within four months of the date of contract signing, despite the fact that it was fabricated in and shipped from the East Coast for erection at the Washington plant. The unit was engineered and furnished by the nation's oldest spray drying engineering firm, Bowen Engineering Inc. of North Branch, N. J. The unit is the largest of its kind used for the spray drying of lignin products in the United States and one of only two of its size in lignin by-products drying operations in the world.

### Halifax

David S. Most will assume the duties of technical service superintendent of Halifax Paper Co. on March 1, 1959. This announcement was made March 1 by K. F. Adams, executive vice-president of the company. In assuming the responsibilities of this position, Mr. Most will replace John J. Priest, who died last December. The technical service section embodies the various technical service functions required by the pulp and papermaking processes at Halifax. These functions include, among other duties, operation of chemical laboratories, product testing for quality, and studies of products, by-products, and wastes.

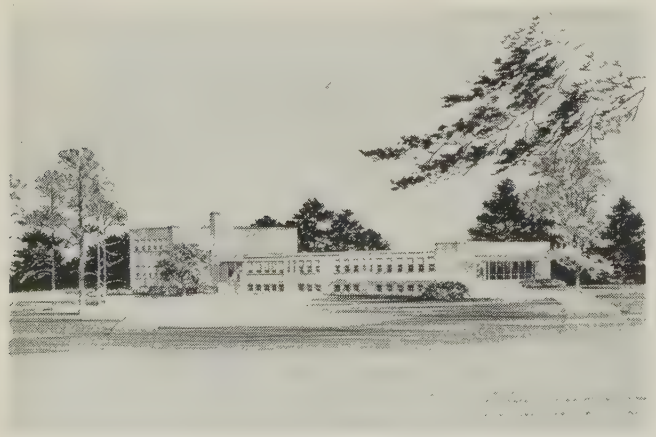
Mr. Most was born in Boston, Mass., and attended secondary schools in Cambridge, Mass. In 1952 he received his A.B. degree in chemistry from Boston University, graduating Cum Laude. From 1952 to 1957 he attended The Institute of Paper Chemistry in Appleton, Wis., graduating with M.S. and Ph.D. degrees.

Dr. Most comes to Roanoke Rapids from the Albemarle Paper Manufacturing Co. in Richmond, Va., of which Halifax is an operating division, where he has served since 1957 as research group leader in the technical division. In his new position, he will continue to work in close association with research and development, and other technical sections of Albemarle.

### Consolidated Water Power

A new lignin liquor processing plant was put into operation in Appleton, Wis. by Barcon, Inc., a recently organized company owned jointly by Consolidated Water Power & Paper Co., Wisconsin Rapids, and Magnet Cove Barium Corp., Houston Tex.

Situated on the site of Consolidated's Appleton Division the $300,000 plant processes concentrated lignin liquor which is a by-product of Consolidated's sulphite pulping operations. Essentially this process consists of converting concentrated lignin liquor into useful products in a dry, powdered form.



***Architect's sketch of the new Research and Development Center now under construction by Consolidated Water Power & Paper Co. of Wisconsin Rapids, Wis. The center is designed to accommodate the company's expanded research program and will be the first unit of what will eventually be a three-unit structure. The building is scheduled for completion in June***

The dried lignin products will be marketed by Magnet Cove Barium Corp. and Consolidated.

"The formation of Barcon, Inc. and start-up of the new plant is another major step in our company's program of developing economic uses for the nonfibrous content of all wood species processed in our papermaking operations. Since 1954 concentrated lignin liquor produced in our Appleton plant has either been sold for chemical uses or utilized as industrial fuel. Further processing in Barcon's plant will open new markets for this product and enable us to increase the capacity of our evaporation plant," Henry P. Baldwin, vice-president—manufacturing, stated.

### Hammermill

Donald S. Leslie, president of Hammermill Paper Co., Erie, Pa., has announced the conclusion of an agreement with American Can Co. for the purchase of the Oswego, N. Y. paper mill now operated by Marathon, a Division of American Can Co. The purchase consideration was not disclosed.

The Oswego operation presently manufactures and converts food board products. The acquisition by Hammermill Paper Co. includes only the paper machine and its auxiliary facilities—and does not include the converting milll of Marathon, located adjacent to the paper mill.

The Oswego paper machine will be rebuilt and converted into a modern fast-running machine suitable for the manufacture of Hammermill products. The modernized machine is expected to have a productive capacity in excess of 30,000 tons per year. The conversion of the machine and its facilities is planned to commence in 1960, with Hammermill taking title and possession on Feb. 1, 1961.

Mr. Leslie pointed out that the Oswego acquisition represents a phase of the company's continuing expansion program. In addition to its important contribution to additional capacity, the Oswego mill is strategically located to provide improved service to Hammermill's customers.

### Ecusta

The largest paper machine in the United States built specifically to produce lightweight papers has started operation at Ecusta Paper in Pisgah Forest, N. C., it was announced today by Arthur J. Loeb, division vice-president. Total cost was more than $6,500,000.

Ecusta, part of Olin Mathieson Chemical Corp., produces lightweight printing papers that will appreciably reduce costs in printing and mailing. It also produces one-time carbonizing tissue and other lightweight specialities.

In preparation for the increased production of the machine, Ecusta has developed a national distribution network, Mr. Loeb declared. New merchants have been named to handle its products and Ecusta's direct sales staff has been expanded.

The new fourdrinier machine is housed in a specially constructed 72,000 sq. ft. which connects with the main Ecusta plant. Called the "Cherokee Arrow" to commemorate the Indian tribe which once inhabited the area, it has a wire width of 182 in. and is capable of operating at speeds up to 1500 f.p.m.—faster than any other machine now producing lightweight paper.

It can produce a variety of lightweight papers from 15 to 40 lb. weights (25 × 38—500) including many new types, and will make easy-to-print lightweight papers available for the first time in areas now dependent on heavier papers.

#### *Tenth Machine*

The decision to expand by adding a tenth fourdrinier machine at Ecusta—which will increase production by 35%—was made three years ago following a study which pointed to a great market potential for lightweight papers, Mr. Loeb declared. The study showed:

(1) The market for one-time carbonizing paper, which it produces, is large and growing rapidly.

(2) Current markets for lightweight papers will grow and new markets will open. The reason: the need to reduce paper costs following increases in costs of mailing, packaging, shipping and handling. The challenge of higher costs will be met by the paper industry by the development of new lightweight papers, he said.

Mr. Loeb predicted that the greatest growth in the use of lightweight papers will take place in such fields as direct mail advertising, catalogues, textbooks, annual reports, prospectuses, and proxy statements.

He said that the study was a step in a long-term plan to diversify the Ecusta line. Ecusta started in 1939 with four fourdrinier machines and was primarily a supplier of cigarette paper. Since then it has twice increased production capacity and expanded to produce Bible papers, cigarette filters, thin publishing papers, wrapping and permanent wave tissues, and other high-quality lightweight papers.

"Ecusta is one of the few mills in this country with a specialized background in lightweight paper, supported by a staff of engineering and scientific specialists," Mr. Loeb pointed out.

*The "Arrow"*

Built to Ecusta specifications by Rice Barton Corp., Worcester, Mass., the no. 10 machine is considered unusual:

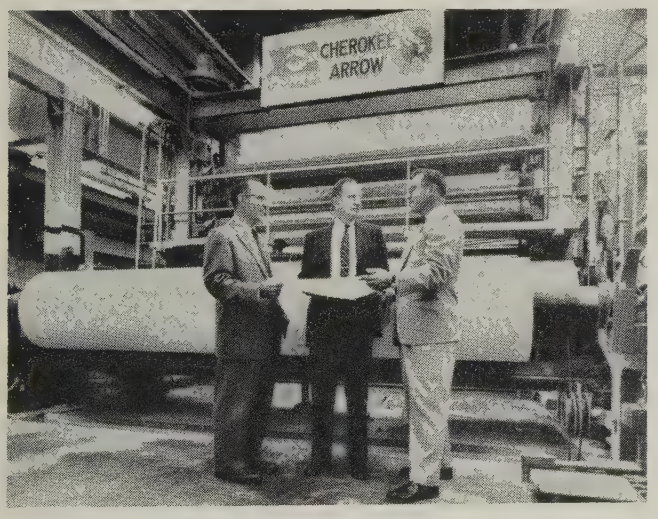
(1) It is the most completely automated machine of its type in the country. Automation of key production steps makes a high degree of quality possible.

(2) Maximum quality control is possible through electronic supervision of the process flow. This keeps specifications for the sheet constant. The Taylor Miniature Transcope, in its first major use in the industry, is the nerve center of this control.

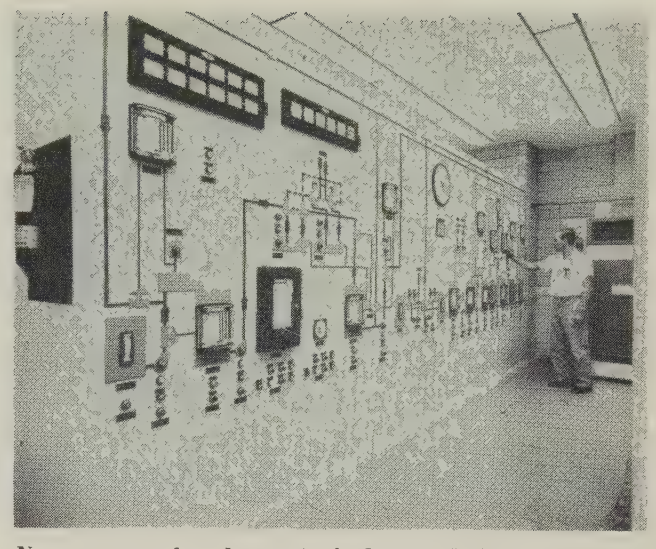
(3) Weight variations within a sheet are measured by beta ray gage. Its use gives much greater control of the weight variations in both the machine direction and cross direction.

(4) The entire machine, including stock preparation, is in line. The fully instrumented stock preparation room is on the same floor as the machine and directly in front of it. This simplifies production.

(5) Paper made on the machine reaches a brightness of from 85 to 95, considered the highest for lightweight paper in the industry.




***The first paper to come off the nation's largest paper machine built especially to produce lightweight paper is examined by executives of Ecusta Paper in Pisgah Forest, N. C. Discussing the product, from left to right, are: W. E. Zimmermann, director of marketing and sales; P. C. Brownell, corporate vice-president and general manager for Ecusta and Film operations; and A. J. Loeb, assistant general manager for Ecusta. Ecusta is part of Olin Mathieson Chemical Corp.***



***Nerve center for the nation's largest lightweight paper producing machine, this control board enables the operator to check quickly all phases of stock preparation. The flow of processed fibers is determined and controlled automatically***

(6) The winder has a differential drive which makes possible finer control of tension than ever before in the roll being wound. Such control is important to printers for high-quality printing work.

(7) There is exceptionally fine moisture control in the sheet. Uniform moisture means less static electricity, making the paper easier for the printer to handle.

(8) Having a wire width of 182 in., it is wider than any other lightweight paper machine.

(9) The no. 10 machine has both endless and seamed felts on the machine. Endless felts are usually found on small machines but are unusual on larger ones.

The Cherokee Arrow is probably the best lighted machine in the paper industry. A new and special type of fluorescent tube, developed by General Electric, is used in the building which gives an even and bright illumination to the entire floor.

Lighting has also been placed in areas normally unlighted such as under machine hoods, over most of the pumps and valves in the basement and in the broke pit.

Care in lighting makes it possible for workers to check the functioning of the machine at all points and makes possible better quality control of product as well as more cheerful working conditions, Mr. Loeb said.

After paper is produced, a shuttle line of automatic conveyors carries the finished rolls from the rewinder to the storage warehouse a floor below. The drop table which receives the rolls is equipped with Toledo scales for weighing. The handling of the rolls is completely automatic.

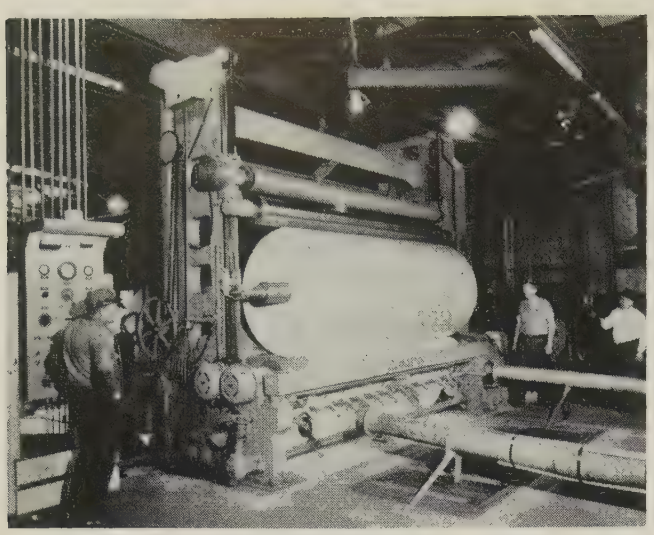
CONTINENTAL

"We're happy about our new Langston winder," says L. G. Wilder, mill superintendent of Continental Paper Co., Ridgefield Park, N. J.

"We can better control the density of our rolls than ever before. We regularly get quality rolls. Spoilage is kept to a minimum," Mr. Wilder adds.

The new winder, installed by Samuel M. Langston Co., Camden, N. J., has been in operation since last December. It takes portions of the production of a 132-in. paper machine and of a 122-in. paper machine and rewinds rolls up to 72-in. diameters.

"There's no guesswork on the part of the operator," explains Maurice Strelitz, engineering supervisor at Continental



***Boxboard is slit and rewound on new winder installed by Samuel M. Langston Co., at Continental Paper Co., Ridgefield Park, N. J.***

Paper. "We're rewinding high quality folding boxboard, ranging in caliper from 16 point to 50 point. We know the best settings for the various basis weights. Thus, we can set for what we want.

"Part of the credit for uniform density must go to the extra heavy and rugged construction of the rider roll assembly. With it we've been able to reduce telescoping of the newly wound roll to an absolute minimum.

"We used to have to stop and put a collar clamp on the roll to prevent telescoping. Now we never have to do that.

"Part of the credit, too, belongs to the automatic tension control in the drive. As the parent roll decreases in diameter, the braking automatically compensates for the reduction in diameter and results in rewound rolls of more uniform density and higher quality.

"The winder is rated at 2000 f.p.m. We've been running it at 1500 to 1800 f.p.m. and have had no trouble at all in keeping up with the portion of our production from the paper machines that goes into roll orders.

"You can say we're fully satisfied with our Langston winder," Strelitz concludes.

The new winder replaced a Langston winder in operation at Continental Paper for 37 years. The old winder was designed for 600 f.p.m. but was operating at 1500 f.p.m. and still turning out good rolls, Strelitz reported, but the company wanted more rugged and more versatile equipment.

### Buckeye

The Buckeye Cellulose Corp. has announced the appointment of Charles A. Montague, Jr., as plant manager of its cellulose pulp plant in Memphis, Tenn.

Mr. Montague succeeds P. S. Moore, Jr., who has been transferred to a management position in Charmin Paper Products Co., Green Bay, Wis. Both the Buckeye and Charmin companies are wholly-owned subsidiaries of the Procter & Gamble Co.

Mr. Montague, 30, joined Buckeye in Memphis following graduation from the University of Tennessee with a civil engineering degree in 1951. He has held several engineering positions with Buckeye, serving most recently as resident engineer for the expansion program at Buckeye's Foley, Fla., pulp plant. Mr. Montague is a member of the Memphis Chamber of Commerce and the Engineers' Club.

Mr. Moore, 38, was named Memphis plant manager in April, 1956. Earlier, he was process supervisor of the Foley plant and plant engineer at the Memphis plant. He joined Buckeye in 1949 after receiving his mechanical engineering degree from North Carolina State College.

### Ontario

An improved process which will produce two and a half times as much vanillin as at present, will be in operation at the Thorold plant of the Ontario Paper Co., Ltd. early next year.

The new development, which originated in the research department with David Craig and C. D. Logan making special contributions, will increase the yield of vanillin by making use of the sludge—the solid waste material left over in the present process and now pounded behind the mill for more convenient disposal. In addition, the new process will produce, in the near future, several by-products for sale commercially, and it will eliminate the problem of pounding the waste sludge.

All these advantages will be gained by using existing equipment in the plant, and by using about the same quantity of spent sulphite liquors. The improved process is probably the most significant advance in vanillin production since the plant was set up six years ago.

The company's original process was the discovery of three men—C. A. Sankey, research director, who also supervised the two-year study leading to the new method; J. H. Fisher, now research director of MacMillan & Bloedel; and H. B. Marshall of the Ontario Research Foundation.

In their method, the spent liquor, after going through the alcohol plant, is treated with lime and air in a reactor under high temperature and pressure. A liquid and a sludge are formed with a vanillin salt being present in both mixtures. The liquid is then separated and carbon dioxide is added to free the vanillin. The liquid is used because it is easier to work with while the sludge is disposed of as waste. However, the sludge, since it also contains vanillin, was regarded by Mr. Sankey and his associates as a potential source of additional vanillin, and this resulted in the intensive studies of the last two years to find an economical method of freeing more of the product from the sludge.

Other pulp and paper companies—Howard Smith Paper Mills, Cornwall, Ont., and Marathon Corp. in Wisconsin—had been making vanillin commercially for about 15 years before the Ontario Paper Co., Ltd. opened its vanillin plant in 1952. However, both these companies used caustic soda in their process, while the Sankey-Fisher-Marshall process was the first to get yields large enough to be commercially acceptable by using lime instead of the more expensive caustic soda. Although the caustic soda method produces more vanillin than does the lime from the same amount of liquor, it is a more expensive process. Mr. Sankey says: "It is not a question of yield per gallon of liquor. The important thing is that lime costs much less than caustic soda and, therefore, we can accept a smaller yield and still make vanillin economically."

Although this same basic process has been in use at the Thorold mill since 1952, there have been improvements over the years as a result of the combined contributions of the research, control and operations departments. "In fact," Mr. Sankey says, "right now we are producing half again as much vanillin as our present plant was designed for." The new process will further increase this production and is another step in the company's continuing program to make the most effective use of all materials used in the manufacture of pulp and paper.

The new processing will take place in the first stage of the vanillin production by treating the sludge as it is formed. Thus, the method combines perfectly with the present plant.

To protect the company's interest, patent applications have been filed on the new process.

From *The Observation Post*, The Ontario Paper Co., Ltd., October, 1958.

### Gulf States

When Gulf States Paper Corp.—long an industry leader in the production of kraft sacks and bags—decided to enter the market pulp field, it left little doubt that the company was aiming for "major league" status.

Near Demopolis, Ala., Gulf States constructed a new mill with a high degree of automation—and the world's largest single continuous digester—to produce high quality, highly bleached sulphate pulp.

Operations began in August, 1957 and less than six months later, the mill had exceeded its rated production of 300 tons of bleached kraft pulp per day.

Heart of the Gulf States mill is the continuous digester, designed by Kamyr, Inc. and built by Chicago Bridge & Iron Co. Its major advantages, outlined by H. P. Halsell, mill resident manager, are: (1) uniformity of pulp quality; (2) stability of steam requirements; (3) ease and accuracy of controlling cooking condition, and (4) reduced labor costs (one man operates the system).

The digester is 88 ft. high, has a maximum diameter of 13 ft. and a capacity of 60 tons of wood chips. Fabricated at CB&I's Birmingham plant and erected by Foreman Nathan Cook's crew, the structure was x-rayed and stress relieved in the field after erection.

CB&I also fabricated and erected a 100,000-gal. elevated tank to serve the Demopolis mill's sprinkler system. The tank was fabricated at Birmingham and erected by Foreman Milton Elkins' crew.

### National Vulcanized Fibre

National Vulcanized Fibre Co. has acquired Parsons Paper Co. of Holyoke, Mass. The Parsons Paper Co., will become the Parsons Paper Division when the transaction is complete.

Parsons Paper Co., was organized in 1853. In explaining the move, a company official states, "Parsons has a well-established business in fine paper which will be continued and promoted. National acquires a source of raw materials used principally in the manufacture of laminated products, which we now have to buy on the outside. We also plan to exploit National's industrial paper technology by selling paper production not required for our own use."

### O-I

Construction of a new corrugated box plant on the Minnesota River 20 miles southeast of Minneapolis will be started this spring by Owens-Illinois Glass Co.

Carl R. Megowen, O-I president, said construction will begin as soon as the weather permits on the new plant for the company's Paper Products Division, of which Lester R. Edwards, O-I vice-president, is general manager. Completion date is expected to be about February 1 of next year.

The new plant will be located in Valley Industrial Park, a 2275-acre tract set aside by the Minneapolis Area Development Corp. for an industrial community. Owens-Illinois, the first to buy land in the park, also will be the first to build there.

Mr. Megowen said that the box plant, together with parking facilities for automobiles and trucks and land necessary for landscaping will take up 21 acres of the 77 acres bought by Owens-Illinois in the park. This will leave plenty of space available for future expansion of box making or other O-I manufacturing facilities.

The new plant will be a concrete block and structural steel building with 153,000 sq. ft. of floor space. The main plant section will be 684 by 202 ft. with an office addition 243 by 50 ft.

The Paper Products Division currently operates a smaller unit at 1000 North Berry St., in St. Paul, whose equipment and personnel will be shifted to the new plant.

The St. Paul operation, referred to as a sheet plant, obtains sheets of corrugated board from the O-I Milwaukee plant, and converts them into shipping boxes.

### Triangle Containers

Norman Albin, president of Triangle Container Corp., Chicago, Ill., announces that Bernard J. Rataj, formerly plant superintendent, has been promoted to vice-president of production.

Bernard J. Rataj has had over 15 years experience in the corrugated box industry. He joined Triangle Container in September, 1955.

Former vice-president of production, Edward J. Rezabek, is now assistant to Norman Albin, of Norman Albin and Associates, in sales and administration. Norman Albin and Associates deal in new and rebuilt machinery for the corrugated box industry.

### Reynolds

In a move to step up the capacity of its new Richmond, Va., printing plant, Reynolds Metals Co. has announced the completion of installation of a high-speed Egan polyethylene coating machine.

The new unit is designed to handle paper and foil, and to make sandwich laminates.

Built by Frank W. Egan & Co. of Somerville, N. J., the coating machine has a 6-in. extruder with 20:1 length to diameter ratio and will take webs up to 44 in. wide.

The web is fed to the machine by a horizontal flying splice unroll and has a turret type flying splice rewind capable of speeds up to 1000 f.p.m. Auxiliary unrolls for foil coating and laminating also were supplied.

An important feature of the line was the attachment of Foxboro recording instruments for continuous recording of screw and web speeds, and the temperature of the polyethylene before it leaves the die.

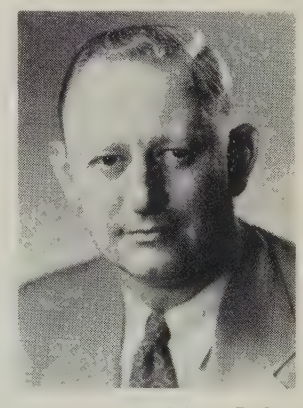
The new line will produce packaging materials for a large variety of foods and other products.

Also installed at the Reynolds Richmond plant by Egan was a laboratory extrusion coating line with $2^1/_2$ in. extruder. The web width is 16 in. and length to diameter ratio is 20:1.

Designed to assist Reynolds engineers in the development of better packaging materials, the lab line is equipped with a turret unwind and rewind.

### Mead Pulp Sales

The appointment of George H. Cash as their technical consultant for the sales, engineering, and design of paper machine hoods and allied equipment has been announced by Nelson Mead, president of Mead Pulp Sales, Inc. According to Mr. Mead, the appointment became effective as of February 9.



*G. H. Cash, Mead Pulp Sales, Inc.*

In making this announcement, Mr. Mead stated "With the appointment of Mr. Cash as our technical consultant, following our appointment in 1958 as the exclusive distributor for the new Fiberglass paper machine hoods and equipment manufactured by Corrosion Controllers, Inc., we are now in a position to offer bleach plants and pulp mills, complete open and closed hoods, auxiliary air systems, and noncorrosive piping."

### Forest Products Laboratory

Eleven new or revised publications on research results have recently been issued by the United States Forest Products Laboratory, maintained in Madison, Wis. by the Forest Service, United States Department of Agriculture in cooperation with the University of Wisconsin.

Five of the publications deal with housing, two with papermaking, and one with the basic research on fire and its control.

Primavera, a Central American hardwood, is described and discussed in Report No. 2021.

Revised Technical Note No. 236 presents data on nail-withdrawal resistance of American woods. Report No. 1740 discusses the application and use in houses of thermal insulation made of wood-base materials; and Report No. 2131 gives results of research on water-vapor permeability of matched barrier materials as yielded by two methods of test.

Report No. 1259 brings up to date the laboratory's information on the two-coat system of house painting, and Report No. 2137 analyzes results of experiments with light frame wall construction for houses.

The papermaking publications are Report No. 2124, "Pulping and Papermaking Experiments on Insignis Pine," and Report No. 2139, "The Groundwood Pulping of Balsam Fir and Jack Pine."

Report No. 1583-B, "Effects of Shear Deformation in the Core of a Flat Rectangular Sandwich Panel," gives test results on compressive buckling of sandwich panels having dissimilar facings of unequal thickness. Report No. 2132, "Hardwood Pallet Manufacturing," combines technical information on pallet construction and design with observations of industrial practices in this field.

The publication dealing with fire research is Report No. 2136, "Theories of the Combuston of Wood and Its Control." It reviews existing information and outlines needed research.

In addition to these reports, the laboratory has issued a revision of its Report No. 513, "List of Publications on Glue, Glued Products, and Veneer."

Copies of these publications can be obtained free on request to the director of the laboratory.

I.P.C.

The National Science Foundation has announced the awarding of grants totaling $20,100 to The Institute of Paper Chemistry in support of two summer programs for college teachers.

In the first program, starting July 7, 10 teachers selected from chemistry departments of small colleges will conduct research for eight weeks on basic problems chosen by them from 15 fields. The purpose of the program is to provide a stimulating research and educational experience. Participants will become familiar with experimental equipment and instruments normally not available on the small college campus. The programs, which will be under the direction of Roy P. Whitney, dean and vice-president of the institute, will include weekly seminars and dinner meetings with distinguished guest scientists and senior staff members of the Institute.

Ten stipends of $600 each will be provided for the eight weeks. Participants will also receive allowances of $120 a dependent up to four dependents and travel allowances of 4¢ a mile up to a maximum of $80. No fees will be charged.

Candidates selected for the summer research program will be those who evidence a sincere interest in the improvement of their teaching through participation in supervised research.

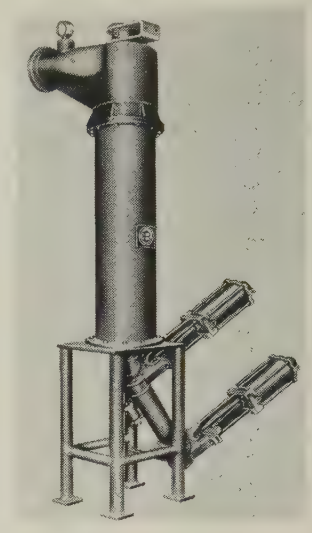
The second program starts on August 16 and consists of a two-week conference in plant biochemistry for 25 college teachers of chemistry and biology. These sessions will seek to develop the mutual areas of interest and importance for the teachers in each field. Elwood C. Dillingham of the Biology Department of the institute will direct the conference which will include lecture-discussions by other senior staff members, meetings with visiting scientists, and a field trip.

Teachers attending the conference will receive stipends of $180 for two weeks and travel allowances of 4¢ a mile up to a maximum of $80. No fees will be charged.

The participants will be selected from those teachers who show a strong interest in relating the fields of chemistry to the broader background of science and life.

B-C

A free-vortex type, nonplugging, high-velocity separator for removing high and medium specific gravity rejects from slushed paper stock has been recently introduced to the paper industry, following several years of development and field testing by the Black-Clawson Co., Shartle Division, Middletown, Ohio.



*Liquid Cyclone*

Named the Liquid Cyclone because of the cyclonic movement of the stock as it undergoes separation treatment, this new unit is entirely self-contained and requires no additional supporting members. A unit to handle 50 tons per day of stock occupies less than 7 sq. ft. of floor space. The Liquid Cyclone is totally enclosed and requires only minimum attention or maintenance.

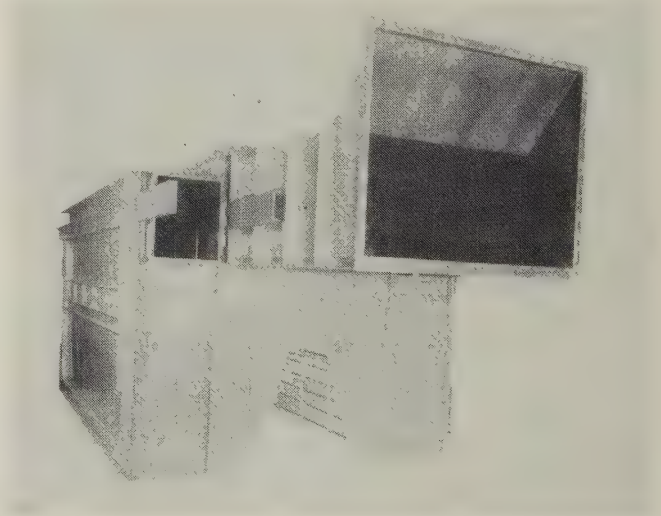
The separation principle involved is rapid downward acceleration of the stock as it enters the unit tangentially at the top. High centrifugal force developed on the stock as it spirals downward towards the apex end of the cone, forces higher specific gravity material such as sand, grit, metal, glass, plastic, paper clips, foil, etc., towards the wall of the cone where it is carried down and out of the unit. Stock movement near the apex forms a cyclonic column of clean stock which discharges from the top of the unit.

Rejected material is passed through the lower chamber, washed free of fibers and ejected from the system. This operation can be either automatic or manual, as preferred.

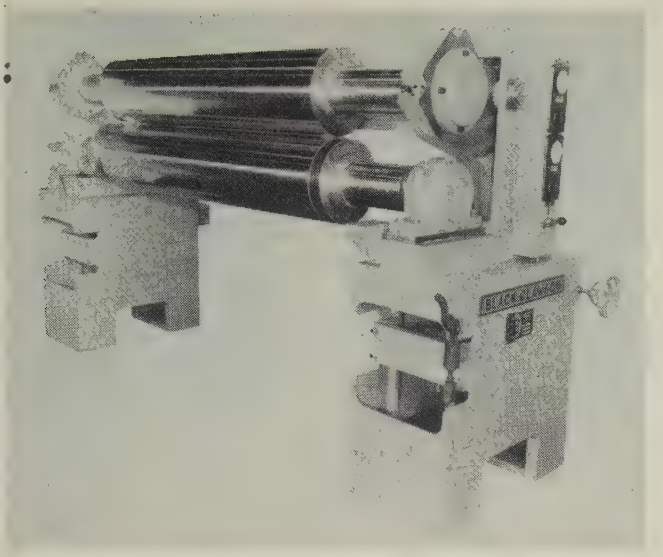
A new heavy duty press section for use in paper saturating and impregnating machine lines was recently built by the Black-Clawson Co. at its Dilts Division, Fulton, N. Y.

The press section features open frame construction for quick and easy roll removal, heavy duty bearings, an air-loading system, mechanical means for controlling accurate nip settings and chrome-plated rolls. Doctors for cleaning rolls can be provided. Full details on construction and application of the new press section can be obtained by writing to Black-Clawson Co., Dilts Division, Fulton, N. Y.

Five promotions and transfers of management personnel in the Paper Machine Division, Shartle Division, and corporate staff of the Black-Clawson Co. were announced recently by



***This Black-Clawson 3-D Drier hood for a 60 in. diam. by 154 in. face drier was recently built and delivered by the Dilts Division, Fulton, N. Y. The drier will be used in conjunction with a Flexiblade coater for on-paper-machine operation. It features high velocity, high temperatures, high volume drying, and a unique air distribution system***



*B-C heavy duty press section*

Frank Peterson, president of the company. Mr. Peterson stated that the changes were made in accord with the company's policy of continually strengthening its divisional structure through utilization to the fullest of the special talents and experience of its officials.

The transfers will be effected in stages during the next six months and will be completed by September 15 of this year.

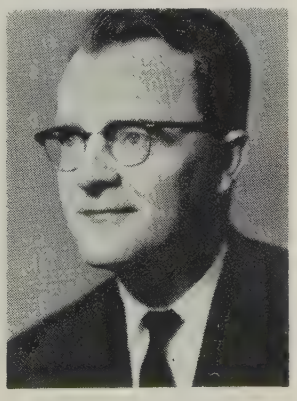
As of May 15, Otto W. Hein, vice-president, transfers from his position as general manager of the Paper Machine Division, Watertown, N. Y. to the corporate staff as vice-president in charge of inter-divisional coordination of plant production, industrial relations, and the company-wide capital investment program. He will concentrate on supervision of shop production activity for all six of the domestic and foreign plants of the company. Mr. Hein will make his headquarters in the Middletown, Ohio plant.

*O. W. Hein, Black-Clawson Co.*

Effective May 15, Joseph E. Hartford, vice-president, will be general manager of the Paper Machine Division. He will transfer from his position as general manager of the Shartle Division, Middletown, Ohio.

Effective September 15, Robert F. Vokes, vice-president in charge of administration, transfers to the position of general manager of the Shartle Division.

*J. E. Hartford, Black-Clawson Co.*



*R. F. Vokes, Black-Clawson Co.*

*C. C. Landegger, Black-Clawson Co.*

*S. T. Weber, Black-Clawson Co.*

Carl C. Landegger, assistant general manager of the Paper Machine Division, is appointed a vice-president of the company. On May 15 he will undertake the position of acting general manager of the Shartle Division and serve until September 15 when he transfers to the corporate office in New York to be administrative vice-president.

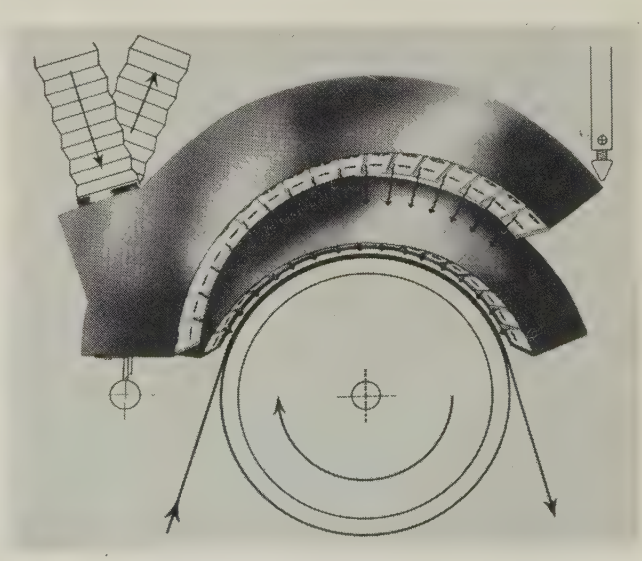
Samuel T. Weber, sales manager of the Paper Machine Division, is appointed a vice-president of the company.

JAGENBERG

Jagenberg-Werke AG, Duesseldorf, West Germany have released for sale in the U.S.A. their new laboratory coater, 12 in. wide, with air knife and smoothing rolls. It is available in the United States from American Paper & Pulp Co., Inc., 300 Fourth Ave., New York 10, N. Y. and Pearce Development Co. 1606 East 30th St., Cleveland 17, Ohio.

J. O. Ross

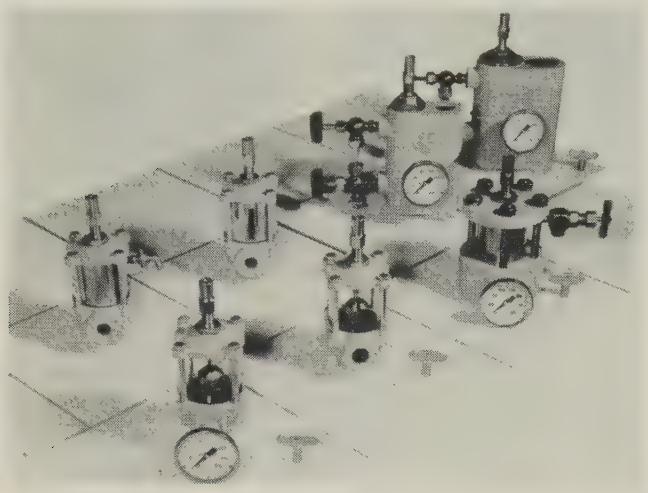
The J. O. Ross Engineering Division, Midland-Ross Corp., 444 Madison Ave., New York, N. Y., announces a new SP high-velocity air drier which not only increases productivity by drying the web at least three times faster, but also offers the major advantage of drying the web uniformly without overdrying it. This, improves product quality and reduces reject rates, and also contributes to increased output by eliminating the necessity for slower speed overdrying often required to properly dry a wet streak. The new SP drier may be used in drying pulp, paper, and paperboard, and in drying coatings applied to these materials. Air velocities range from 15,000 to 20,000 f.p.m.



*SP high-velocity air drier*

### Stickle

A new line of micro adjustable orifices has been introduced by Stickle Steam Specialties Co., 2215 Valley Ave., Indianapolis 18, Ind.



The orifices are designed to provide more accurate drainage of condensate from heating and processing units operating at pressures between 5 and 400 p.s.i. Because they require virtually no maintenance and offer precise adjustment for minimum steam loss, orifices are frequently used to replace hard-to-maintain steam traps.

### Scott Testers

Scott Testers, Inc., makers of physical testing equipment since 1899, offer "CRE Tensile Tester Bulletin," a 6-page illustrated brochure describing entirely new Scott constant-rate-of-extension tensile elongation tester, with ultraprecise electric weighing, for stress-strain evaluation of all materials in the range 0–0.05 lb. to 0–1000 lb. or 0–25 g. to 0–500 kg. tensile. Features low cost due to a design concept of a basic tester tailored to the user's application, with additional options to provide laboratory versatility, and over 150 Scott clamps and holding fixtures for conformance with ASTM and ISO methods. The booklet is available from Scott Testers, Inc., 53 Blackstone St., Providence, R. I.

### Ingersoll-Rand

To conserve time, reduce operating costs, and remove pressure from the busy shop crane, Ingersoll-Rand Co. has developed two new lightweight, portable, air hoists, designed to be easily moved and installed by one man.

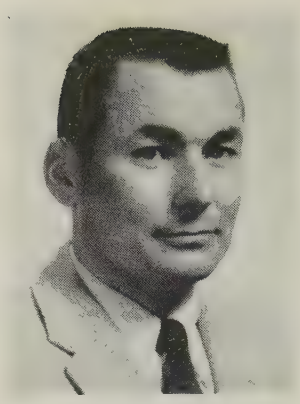
The 1000-lb. capacity hoist weighs 39 lb. and lifts its rated load at 45 f.p.m. The 2000-lb. hoist weighs 56 lb. and lifts its rated load at 22 f.p.m.

For further information write to Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

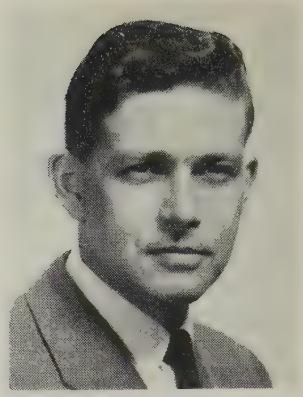
### Texas Gulf Sulphur

Plans to establish a molten sulphur terminal at Tampa, Fla., employing for the first time an ocean-going vessel especially designed for the shipment of sulphur in liquid form, were announced recently by Texas Gulf Sulphur Co. and DeBardeleben Marine Corp. of New Orleans, large water transportation organization.

According to spokesmen for the two companies, beginning in August, molten sulphur will be shipped to a new DeBardeleben terminal at Tampa from Texas Gulf's loading terminal at Beaumont, Tex., in a Liberty vessel recently purchased and to be converted by DeBardeleben Marine. The sulphur transport will be equipped with steam-heated tanks capable of holding 7500 tons of molten sulphur, making it the largest carrier ever used for liquid sulphur shipments.



*R. W. Anderson, Appleton Woolen Mills*



*D. H. Johnson, Appleton Woolen Mills*

### Appleton Woolen

Appleton Woolen Mills has announced the appointment of two men to fill newly-created supervisory positions.

Ronald W. Anderson has been named plant engineer, Don H. Johnson is personnel manager. Both these positions, a company spokesman said, were developed to provide necessary services resulting from the increased volume of business reported by the Appleton, Wis., manufacturer of papermakers' felts.

### Monsanto

The versatility of solid plasticizers in adhesives, lacquers, foams, films, and rigid plastic compositions is detailed in a new booklet published by Monsanto Chemical Co.

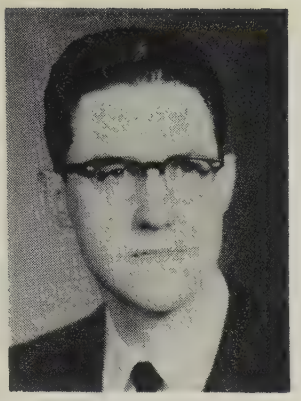
The booklet also lists the specifications of 14 solid plasticizers available from Monsanto's Organic Chemicals Division.

***Officials of the D. M. Bare Paper Co. of Roaring Spring, Pa., were on hand for the arrival last week of the first tank car of Mersize fortified pale rosin size to be shipped from Monsanto Chemical Company's new producing unit at Nitro, W. Va.***

***Harold S. Vanderhei (second from left), vice-president and general manager of Bare, headed the executive group which included, to his left: Vance D. Myers, purchasing agent; Walter E. Spearin, production superintendent, and Carl L. Martin Sr., Bare's director of purchasing and assistant treasurer. They were joined by J. D. Wright (far left), manager of Monsanto's Pittsburgh district sales office.***

***Paper mills in western Pennsylvania, New York, and the midwestern states can save three to four days of shipping time on fortified pale rosin size from the new Mersize producing point, according to Monsanto. It is the northernmost integrated rosin and size producing facility in the United States***

*L. G. Ward, Huyck Felt Co.*



*J. W. Welch, Huyck Felt Co.*

### Huyck Felt

Huyck Felt Co., Division of F. C. Huyck and Sons, Rensselaer, N. Y., has further expanded its felt development department by the addition of two research engineers, Lowell G. Ward and J. W. Welch.

Response to Huyck Felt Co.'s continuation of felt workshops in the year 1959 has been so overwhelming that the company reports only a few openings remaining for classes scheduled for June 24, 25, and 26, and September 16, 17, and 18. Papermakers concerned with felt operation, who wish to earn their "degree" in Applied Felt Technology by attending one of these sessions, are urged to register promptly. The March class was filled to capacity.

### Chemical Linings

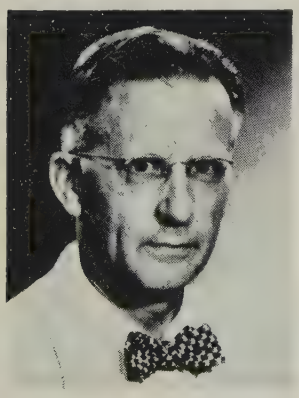
Murray H. Bennett, president of Chemical Linings, Inc. announces that Warren K. Brown has been elected vice-president in charge of engineering. W. James Heuer of Seattle, Wash. has been elected vice-president in charge of West Coast operations. This office is located at 421 Jones Building, Seattle, Wash.

### Rhodia

The appointment of Walter C. Meuly as director of research for Rhodia, Inc. has been announced by the president, Raymond J. Picard.

### Chas. T. Main

Nicholas Bachynski, of Lyndhurst, Ohio has joined the Pulp and Paper Group of Chas. T. Main, Inc. as a member of the engineering staff. Prior to his affiliation with Chas. T. Main, Inc. Mr. Bachynski was with Reliance Electric and Engineering Co. of Cleveland, Ohio serving as an application engineer, branch sales manager, and subsequently as manager of market research for the company.



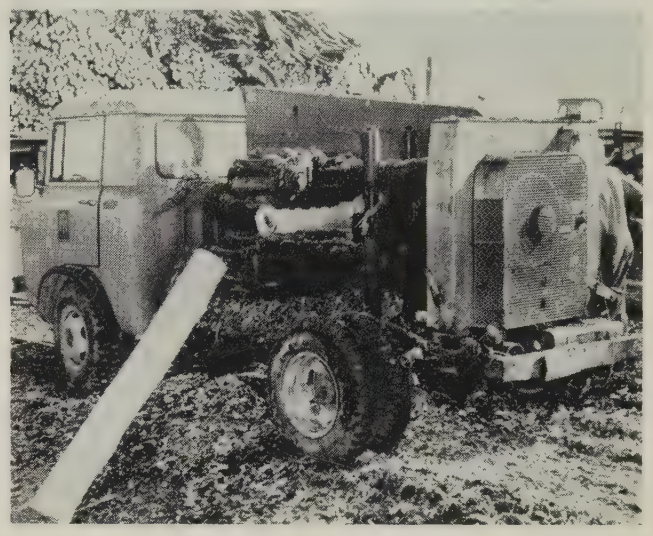
*W. C. Meuly, Rhodia, Inc.*

*Nicholas Bachynski, Chas. T. Main, Inc.*

### Canadian Ingersoll-Rand

A new log barker developed in Canada for North American conditions is manufactured by the Canadian Ingersoll-Rand Co. in their Sherbrooke, Que. factory.

Mobility is claimed to be an important feature of this new machine which, according to the manufacturer is "ready to drive right into a wood lot and be at work in minutes."



***Canadian Ingersoll-Rand log barker***

The barking component is mounted on an FC 170 Willys Jeep chassis with 4 wheel drive and heavy duty springs and shocks. This means that 105 b.hp. is available for over-the-road transport. The barking mechanism is driven from the same engine utilizing 35 hp.

For complete specifications and information write Canadian Ingersoll-Rand Co. Ltd., 800 Birks Bldg. Montreal, Que., Canada. Arrangements have been completed for field demonstration.

### A. E. Staley

A new series of noncongealing starch products developed by the A. E. Staley Manufacturing Co. is showing distinct advantages in a wide range of surface sizing and coating applications in the paper industry, Staley researchers report.

First-perfected products in the new Staley series of starch-derived acetate gums are already being marketed under the brand name "Mira-Film."

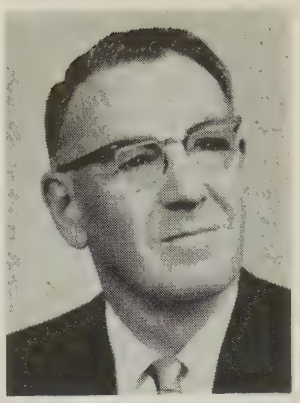
The new series of Mira-Film acetate gums ranges from high to very low viscosity. Extensive laboratory and mill tests have shown effective performance in many varied surface sizing and coating applications. Technical data sheets on the new Mira-Film acetate gums are available from Staley representatives, branch offices in Atlanta, Boston, Chicago, Cleveland, Kansas City, New York, Philadelphia, St. Louis, and San Francisco, or by writing the company at Decatur, Ill.

### Reichhold

Reichhold Chemicals, Inc., has announced the creation of a Paper Division in order to provide better customer service to the pulp and paper industry. William H. Shockley has been named to head the new division. Mr. Shockley has a diverse background in paper manufacture and research.

Principal products of the division are urea formaldehyde, phenol formaldehyde, polyvinyl alcohol, polyvinyl acetate, and various acrylic resins. These are used in making wet-strength papers, water resistant paper adhesives and paper coatings. Resistance to weakening by water is necessary in

*W. H. Shockley, Reichhold Chemicals*



*A. C. Dreshfield, The Glidden Co.*

such paper products as towels, tissues, bags, outdoor posters, map paper and blueprint paper.

These wet-strength resins have been made and sold by Reichhold for many years and the steady increase of business from the pulp and paper industry has prompted the establishment of this new division. With 15 plants located all over the United States, RCI is strategically located to serve every major pulp and paper producing area in the country. And several of RCI's foreign plants are similarly well situated with respect to major producing areas in Canada and Europe, as well.

The large chemical concern also maintains paper research laboratories in Tuscaloosa, Ala.; Detroit, Mich.; and South San Francisco, Calif. Mr. Shockley also indicated that paper service and research facilities will be added at some of the seven other domestic RCI laboratories when they prove necessary.

### Glidden

Appointment of Arthur C. Dreshfield as director of paper research and development for the Glidden Co.'s Chemicals-Pigments-Metals Division has been announced by George M. Halsey, vice-president in charge of the division.

In this newly-created position with Glidden, Mr. Dreshfield will direct all research and development activities as well as technical sales services in connection with the Chemicals-Pigments-Metals Division's constantly expanding program of services to the papermaking industry. He will be headquartered at the division's new papermaking and coating research laboratory in Baltimore.

### Lee, Revere & Van Buren

Super-Sulfamic dry acid cleaner is based on sulfamic acid. Sold and handled dry, it is said to clean industrial equipment more easily and more safely than hydrochloric acid can. There are no fumes whether used dry or dissolved in water. It is available from Acid Div., Lee, Revere and Van Buren Chemical Co., 432–8 West 70th Terrace, Kansas City 13, Mo.

### Patton Mfg.

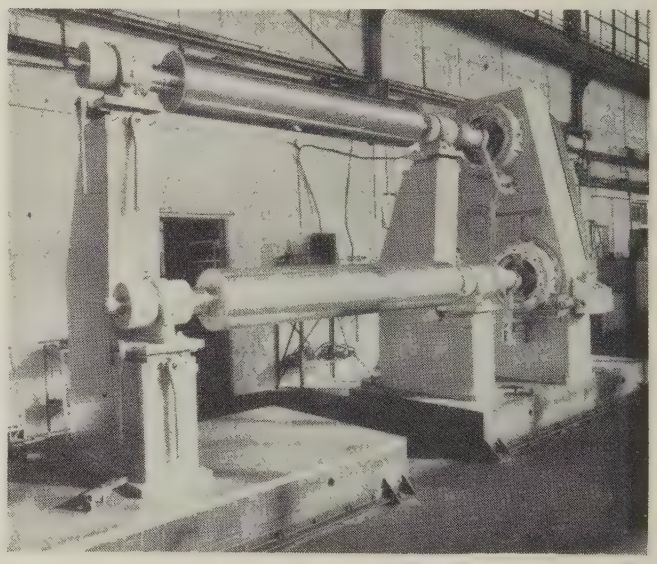
Olaf S. Antonsen has been appointed fourdrinier and wet end project engineer by Patton Manufacturing Co., paper mill machinery builders of Springfield, Ohio. The announcement was made this week by Wayne T. Crannell, general manager of Patton's paper mill machinery division.

The appointment of Mr. Antonsen closely follows the appointment of Frank Scribner who joined Patton last month, also as project engineer. The appointment of these two project engineers by Patton is a part of the firm's current expansion of its engineering department and the initiation of a special mill machinery equipment design service to the industry geared to design and build special application paper mill equipment.

Patton Manufacturing Co. of Springfield, Ohio has introduced a new reel design, a modernized and up-to-date version of a two drum upright reel. This Patton reel has various unusual features. One is the fact that the reel is driven by an electric a.c. motor, an unusual aspect because reels are usually driven from the paper machine line shaft. Patton points out that in a recent installation its reel design eliminated the necessity of extending the machine line shaft.

*O. S. Antonsen, Patton Manufacturing Co.*

The new Patton reel is also adaptable to direct drive from adjacent drive shafts such as from the machine calendar or from a counter shaft located either overhead or in the machine basement. The Patton reel is equipped with a water-cooled brake with an unusual flanged mounting arrangement. Both air-cooled slip clutch and water-cooled brake are of Fawick design and manufacture.



*New Patton reel*

The new Patton reel design was introduced last month, according to Wayne T. Crannell, general manager of the Patton paper mill machinery division.

### Witco

Witco Chemical Co. Inc., announces the merger of Emulso Chemical Corp., Chicago—a Witco subsidiary—with Witco's Organic Chemicals Division.

A major purpose of the move is to widen distribution of Emulsol products through the use of the parent company's extensive sales force. The Emulsol sales staff will be absorbed into the Witco organization. A. O. Raven, formerly Emulsol sales manager, has been appointed products manager of the Emulsol products line.

### D. J. Murray

Jack R. Haller has been appointed chief engineer of D. J. Murray Manufacturing Co., Wausau, Wis. The appointment was effective March 1, according to A W. Plier, president and general manager of the firm.

### Nalco

Changing the name of National Aluminate Corp. to Nalco

Chemical Co. was recommended to stockholders for approval at the Chicago annual meeting April 27.

Joseph A. Holmes, president, said proposals to adopt the new name and to increase the number of authorized common shares from $1^1/_2$ million to 3 million would be considered as amendments to the company's certificate of incorporation.

### Torrington

The Torrington Co. announces the availability of a comprehensive catalog covering the design and application of spherical roller bearings.

The new Catalog No. 258, covers five standard series of self-aligning spherical roller bearings, with bore sizes ranging from 40 mm. up through 1060 mm. A copy of Catalog No. 258 may be obtained by writing on your letterhead to The Torrington Co. Bantam Bearings Division, South Bend 21, Ind.

### Valmet

Valmet headboxes are to be made in England on license basis. A paper machine headbox, for which a patent has already been granted in many countries, has been developed under the direction of Erkki Ikävalko at Valmet Oy's Rautpohja Works in Jyväskylä.

The Valmet pressure headboxes, already delivered for paper machines in many countries, have aroused considerable attention among the experts in the field as well as among the users and machine builders.

Millspaugh Ltd., the world-renowned English producer of papermaking machinery has acquired the rights to manufacture it.

### Dow

The Dow Chemical Co. has completed a 32-page bulletin about Dowpac, the company's new plastic packing material used in the biological oxidation of liquid wastes. Copies of the booklet, "Dowpac-Applications in Waste Treatment," are available by writing to Plastics Merchandising Dept., the Dow Chemical Co., Midland, Mich.

### Hanchett

The Hanchett Manufacturing Co. of Big Rapids, Mich. and Portland, Ore. has announced the construction of a new branch office, factory, and warehouse located at Fifth Ave. South and 31st St., Birmingham, Ala. Complete stocks of all Hanchett products, such as saw sharpeners, knife grinders, saw swages and swage shapers will be maintained at the new branch and factory. Trained service men will be available to purchasers of new Hanchett grinders to assist in procuring the most efficient and satisfactory operation of all Hanchett equipment and to help in training and instructing new operators and personnel.

### Oilgear

Bulletin 10051–G, 12 pages, includes specifications, illustrations and descriptive matter on the complete line of standard Oilgear and Servocontrol Division equipment. It is available from the Oilgear Co., 1572A W. Pierce St., Milwaukee 4, Wis.

### Carthage

Based on the acceptance of the Carthage knife assembly in the Carthage 47-in. slab chippers, the Carthage Machine Co. is now equipping its 39-in. slab chippers with this new assembly.

One important advantage of this assembly is that chip lengths can easily be changed simply by changing the knife holders. There are no field adjustments, which eliminates guesswork. The knives can be shimmed in the shop and are the correct width when placed in the disk, thus eliminating field shimming.

### Dorr-Oliver

Dorr-Oliver Inc. transferred its filtration engineering and development operations from Oakland, Calif. to Stamford, Conn. Jan. 1, 1959. Part of a long-range plan for centralization of all filtration engineering and manufacture in the east, the move provides better service to customers through improved engineering and production communication. Manufacture of Dorr-Oliver filtration equipment is already centered at the company's substantially expanded Hazleton, Pa. plant, close by the new Stamford International headquarters where the majority of Dorr-Oliver engineering and development operations are located.

### Borden's

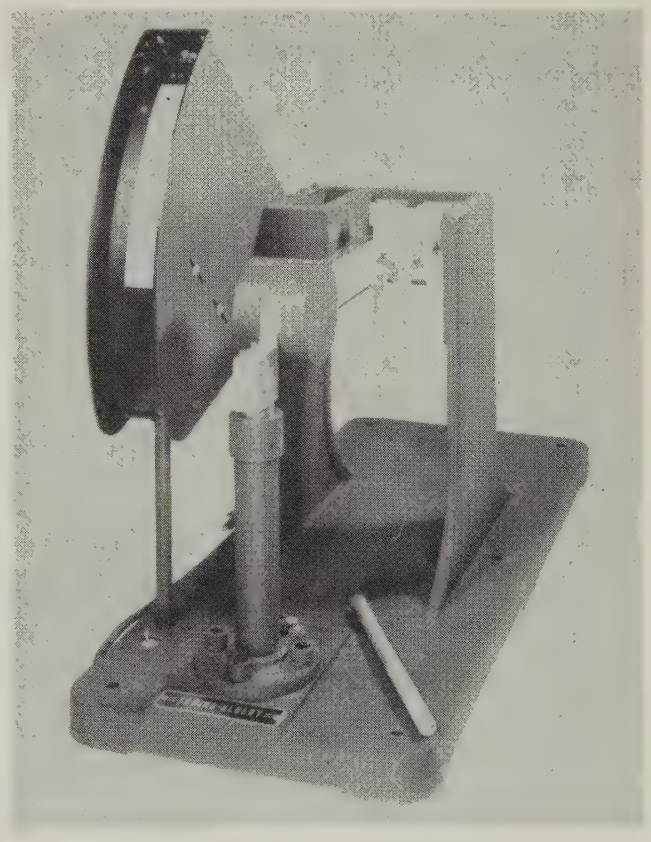
Construction of a polyvinyl alcohol plant designed to produce 5 million lb. per year and scheduled to go on stream in October, 1959, has been announced by A. R. Marusi, president of the Borden Chemical Co.

The new Borden plant, being erected at a cost of $1.5 million, will adjoin the company's present polyvinyl alcohol plant at Leominster, Mass., where the company also manufactures polyvinyl chloride, polyvinyl acetate beads and emulsions, and specialty monomers.

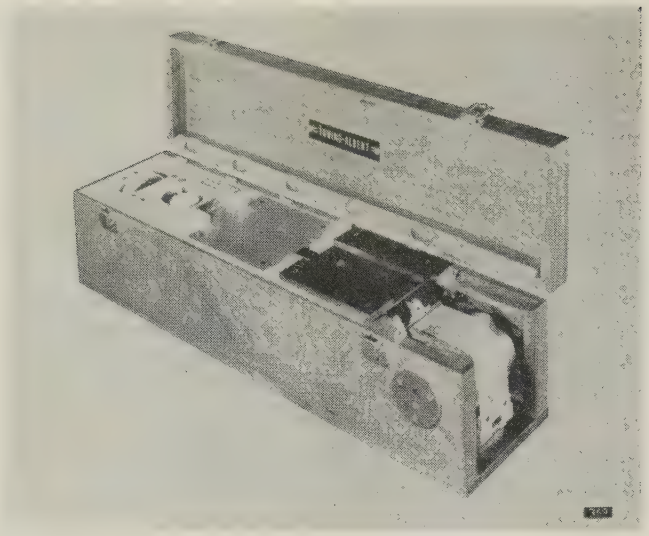
A new continuous process, developed and engineered by Borden technicians during the last two years, will be employed in the new plant, Mr. Marusi said. The new process not only will assure the production of extremely high-quality polyvinyl alcohol, but also will be versatile enough to produce all grades and viscosities on a continuous basis, he added.

### Thwing-Albert

Thwing-Albert Instrument Co., maker of the Elmendorf tearing tester, is now producing a heavy duty torsion tear tester to measure tearing strength of strongly directional materials which tend to tear at an angle from the application of force.



*Thwing-Albert heavy duty torsion tear tester*



*Thwing-Albert T-A-C tester*

The torsion tear tester holds the specimen rigidly throughout its entire length on both sides, and the tearing force is directed to produce a tear down the center line of the specimen.

The tester measures the tear strength of cylinder board, corrugated board, glass fiber reinforced gummed shipping tape, vinyl and rubber sheeting, gauze, and other woven fabrics.

It is made by the Thwing-Albert Instrument Co., Penn St. and Pulaski Ave., Philadelphia 44, Pa.

The new Thwing-Albert T-A-C tester predicts the production performance of water and solvent based adhesives and rewettable adhesives, such as gummed tape, by putting adhesives and adherends under simulated production-use conditions right in the laboratory.

The T-A-C tester works on the principle of bonding two adherend surfaces by an adhesive and measuring the strength of the bond by its resistance to shear or peel forces either on a curved surface or a flat surface. In the T-A-C tester the variables of bonding pressure, adhesive film thickness, open time, and closed time are all controlled making it possible to decide on the best adhesive, the optimum adhesive film thickness, the best bonding pressure, and the optimum open and closed time.

Tests can be conducted for bonding operations involving the bonding of paper, paperboard, textiles, plastics, plastic films, glass, leather, rubber, metal foils, metals, wood, and ceramics.

The Thwing-Albert T-A-C tester is made by Thwing-Albert Instrument Co. at Penn St. & Pulaski Ave., Philadelphia, 44, Pa.

### Diamond Power

The Diamond Power Specialty Corp., Lancaster, Ohio has announced the consummation of a licensing agreement with A. Ekstroms Maskinaffar, of Stockholm, Sweden, covering the Broman-Ekstrom shot cleaning system. This system offers improvements in cleaning certain heating surfaces such as tubular airheaters, horizontal superheaters, reheaters, and economizers.

Cleaning is accomplished by cascading steel shot uniformly over the heating surface. The shot is recovered and reused indefinitely—being automatically recirculated by a pneumatic system as required.

### Hagan Chemicals

One of the world's largest producers of carboard and paperboard, Whippany Paper Board Co., has reduced steam line maintenance more than 60% through the use of Hagafilm—a filming amine product of Hagan Chemicals & Controls, Inc., Pittsburgh.

Joe Krobath, chief engineer at Whippany's Clifton, N. J. plant, adds the chemical product to the boiler feedwater. A thin protective film is formed on metal surfaces contacted by the condensate, effectively controlling rust and corrosion.

"The proper use of Hagafilm is important to get the best results," emphasized Mr. Krobath. "We make up a batch every eight hours, using hot condensate at temperatures between 130 and 170°F. The batch is proportioned so that we use $1^1/_4$ parts Hagafilm per million pounds of steam. We generate about 4,800,000 lb. a day. Proportions were slightly higher when we first started using Hagafilm, but that was to clean out existing scale deposits and corrosion."

For application information on Hagafilm, write to Hugh E. Carr, Hagan Chemicals & Controls, Inc., Box 1346, Pittsburgh 30, Pa.

### Stowe-Woodward

"What is the Rubber Industry?," a publication of the Rubber Manufacturers Association, Inc. is offered, without charge, by Stowe-Woodward, Inc. The pamphlet is an informative and enlightening report on the rubber industry—its past, present, and future. Copies may be secured by writing to Stowe Woodward, Inc., Newton Upper Falls, Mass.

### Clinton Corn Processing

The appointment of George B. Redmond to the newly created position of manager—industrial sales, has been announced by H. A. Bendixen, vice-president and general sales manager, Clinton Corn Processing Co., Clinton, Iowa.

### American SF Products

"There is good reason to believe that 1959 will see a resurgence in the ordering of capital goods for the pulp industry," said Mr. Arne Hallencreutz, president, American SF Products, Inc., who recently completed a journey through the major pulp manufacturing districts in the United States. American SF Products, Inc., is a subsidiary of AB Svenska Flaktfabriken, Swedish manufacturer and engineer of Flakt driers as well as heating and general mill ventilating systems.

"Last year saw a very satisfactory development with total concern sales exceeding $20 million," said Mr. Hallencreutz. "We are pleased with the general acceptance of our new Type L. Flakt drier with airborne web. By the end of the year we had 12 such driers, ranging in capacity from 66 to 420 tons a day, under construction or in order. Seven of these orders actually were written during a period of a few months last fall."

"The incoming business has made it possible for our plants to maintain a full work schedule despite lay-offs in many sectors of the heavy Swedish manufacturing industry. Current sales contract negotiations also appear to indicate that we will continue throughout the year with a substantial backlog of orders."

One of the new Type L Flakt driers is currently under construction at Bowaters Carolina Corp.'s new mill at Catawba, S. C.

AB Svenska Flaktfabriken, which has manufactured Flakt driers since 1929, has its head office in Stockholm, Sweden, and manufacturing plants in Sweden, Finland, Norway, Denmark, Belgium and France. Subsidiaries and sales offices are located all over the world. It is estimated that some 6 million tons of pulp is dried annually in driers made by AB Svenska Flaktfabriken.

American SF Products, the American subsidiary, is located at 420 Lexington Ave., New York City. It was established in 1955. A resident engineer's office is located at 3272 Peach Tree Rd., Atlanta 5, Ga. Many Canadian pulp mills are using Flakt driers supplied by SF Products Canada, Ltd., 940 Cote de Liesse Rd., Montreal, Que., AB Svenska Flaktfabriken's Canadian subsidiary. There are at present 235 Flakt driers for pulp in operation of which 10 are located in the U.S.A. and 27 in Canada.

### Fischer & Porter

Doug Dismukes has been promoted to the newly-created position of water and waste industry manager of Fischer & Porter Co., manufacturer of flowmeters, process instruments, chlorination equipment, automation equipment and laboratory glassware.

### Research-Cottrell

The election of Lawrence M. Roberts as senior vice-president has been announced by Research-Cottrell, Inc., Bound Brook, N. J., engineers, manufacturers and constructors of industrial gas cleaning equipment and industrial gas handling consultants.

At the same time, three sales appointments for the firm were announced by W. W. Moore, vice-president for sales.

Mr. Moore named William H. Blessing as New York district sales manager, Richard H. Betchley as San Francisco sales manager, and Robert L. Sferra as sales engineer for the San Francisco district.

In addition to his new duties as senior vice-president, Mr. Roberts will continue in charge of engineering and research and as a director, duties he has carried out as a vice-president since 1954.

### Hooker

Hooker Chemical Corp. will divisionalize further by forming an autonomous Eastern Chemical Division and by also making autonomous the earlier-formed Phosphorus Division, placing both on the same basis as its Durex Plastics Division. Effective March 12, 1959, the date of Hooker's directors' meeting, Thomas F. Willers and F. Leonard Bryant, vice-presidents, were appointed general managers of the Eastern Chemical Division and the Phosphorus Division, respectively. The announcement is made by Thomas E. Moffitt, president.

Headquarters for the Eastern Chemical Division will be at Niagara Falls, with plants at Niagara; Montague, Mich.; and Columbus, Miss. Phosphorus Division headquarters will remain at Jeffersonville, Ind., with plants at Jeffersonville; Columbia, Tenn.; Adams, Mass.; and Dallas, Texas.

For the time being, Hooker plans no change of status for its Tacoma, Wash., plant and its Canadian subsidiary, Hooker Chemicals Ltd., at North Vancouver, B.C. Hooker wholly owns 12 plants, including the three plants of the Durez Plastics Division.

### Sprout-Waldron

The design of a new type stock preparation pressurized refiner with a unique twin-flow feed arrangement and self-balancing thrust has been announced by Sprout, Waldron and Co., Inc.

Basic to the new design is a floating rotor shaft assembly rotating between a fixed and movable head. A set of refining plates is mounted on each face of the rotor as well as on the two stationary heads. Pressure between the refining plates is hydraulically controlled. The unusual design of the twin-faced rotor eliminates the necessity for heavy duty thrust bearings and simplifies maintenance.

The availability of a detailed technical report on the cold caustic pulping of mixed hardwoods, prepared by B. H. Bamer, mill manager and H. Miller, pulp mill superintendent of Stone Container Corp. Coshocton, Ohio, has been announced by Sprout, Waldron & Co., Inc. Bulletin P-44 describes the process in detail, includes a flow sheet and gives full description of the equipment.

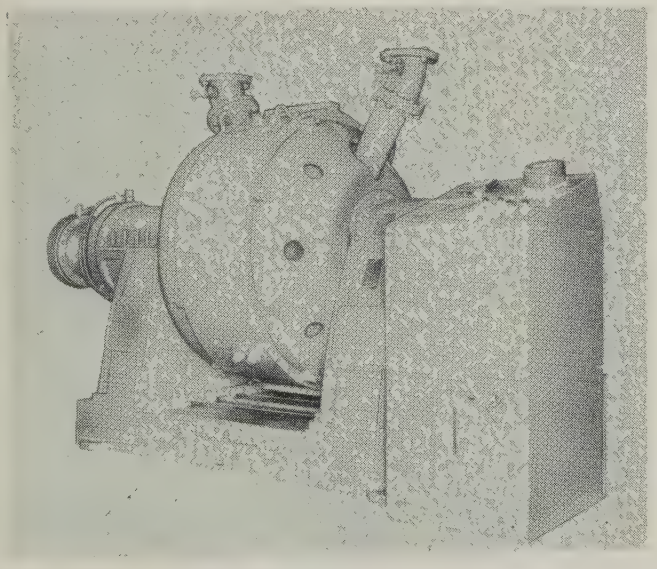
### Bolton-Emerson

The Emerson Manufacturing Co., Division of John W. Bolton & Sons, Inc., Lawrence, Mass. has introduced the Emerson pulper featuring a unique tub design engineered to accomplish complete, uniform pulping at 6 to 12% consistency in average cycles of from 20 to 30 min., depending upon the type of furnish and the degree of defibering required.

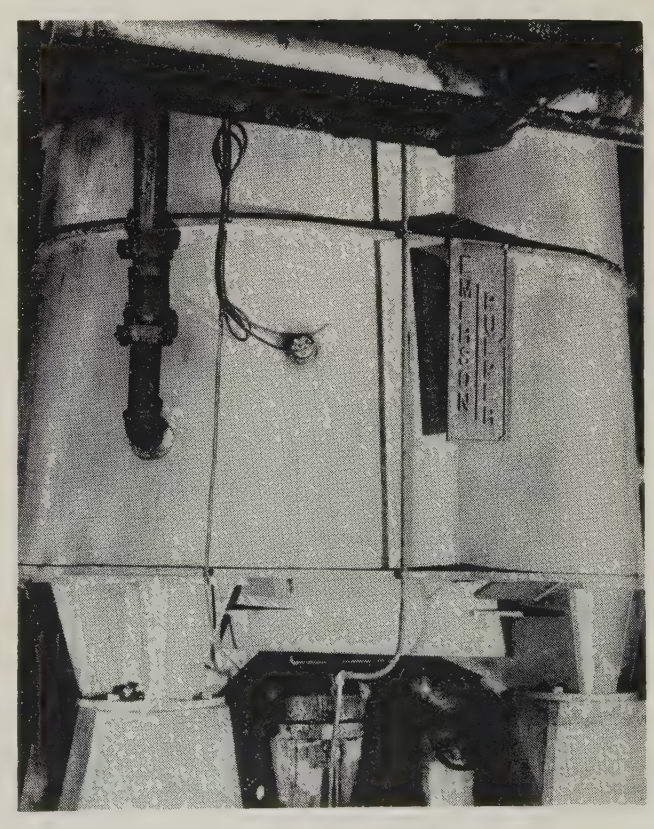
Utilizing a minimum of floor space, the tub contains four lobe-shaped sections with sides tapering inward toward the top. Action of the impellor forces the stock out and up the sides of each lobed section, which directs the stream back to the impellor blades allowing no dead spots for undefibered stock to escape. The four resulting streams of stock form an interweaving, overlapping pattern at the vortex to assure vigorous defibering action on the stock.

Emerson pulpers are made in five sizes. The range from 1000 to 5000 lb. units, with a capacity range of from 9 to 180 tons per day at standard rating of 6% consistency and are available in stainless, carbon steel and tile.

A new bulletin on the Emerson Triple Attack Pulper is available by writing the Emerson Manufacturing Co., Lawrence, Mass.



*42-in. Sprout-Waldron pressurized refiner*




*Emerson Triple Attack Pulper*

After nearly 10 years of research and development, metallurgists at John W. Bolton & Sons, Inc., Lawrence, Mass., have perfected a metal that combines and retains all the mechanical properties essential to jordan refining. Called Bolton special stainless steel, it is a chrome-nickel alloy having essentially the same chrome and nickel content as AISI 300 series stainless, plus other elements. Development of Bolton special stainless is recognized as an outstanding metallurgical achievement.

Now the properties of both wear-resistance and corrosion-resistance are combined in the same metal. Previously, it was necessary to sacrifice one property in order to have the other. In addition, Bolton special stainless has the toughness to withstand deformation without fracture and to take severe shock without structural failure.

Extensive laboratory and field tests were conducted in the development of Bolton special stainless in line with the continuing program of research and development by the manufacturer of Bolton machine knives and Emerson pulp and paper mill equipment. Manufacturing techniques made possible the unique combination of desirable properties inherent in the Austenitic grades of stainless, previously considered best for corrosion resistance. By the addition of other elements, precipitation hardening, a form of in-plant heat treating never before used commercially on steel for refining equipment, was introduced.

One advantage of precipitation hardening is that all machining and straightening is done while metal is in the solution-annealed condition. As a result, all stresses are removed by the precipitation treatment that follows. Another big advantage is that mechanical properties of the metal can be varied to meet differing paper mill requirements. Shown here are results of several heat treatments, each accomplished for a different mill application.

| *Brinell hardness* | *Tensile strength* | *Per cent elongation (2 in.)* | *Per cent reduction of area* |
|---|---|---|---|
| 321 | 180,200 | 16.4 | 74.2 |
| 363 | 199,300 | 14.5 | 41.9 |
| 415 | 211,700 | 14.0 | 32.1 |

Bolton special stainless made its first appearance in the paper industry in 1948. Since, performance analysis under a myriad of operating conditions has proved its value. As the advantages of using Bolton special stainless in jordan refining equipment have proved outstanding, other uses calling for a metal with its mechanical properties suggest its use in beater fly bars, doctor blades and other process replacement parts.

### Chemical Research Laboratories

Chemists at the Chemical Research Laboratories of America, Inc., in Rhode Island, are keeping up with the key words of "growth and development" in the papermaking industry, with continuing research and development towards cheaper, more efficient products to assist the paper manufacturer.

Recently Dioxcide, a potent total germicide, was developed as a slime-controlling agent for paper manufacturing. Its introduction to the papermaking process should result in some startling results in economy, effectiveness, and ease in handling, the company states.

Dioxcide is colorless, odorless, nontoxic, and nonirritating. It is said to be a stable, efficient, oxidizing agent, which when added to the wet end of a papermaking system becomes a constant slime-preventing agent.

### G.E.

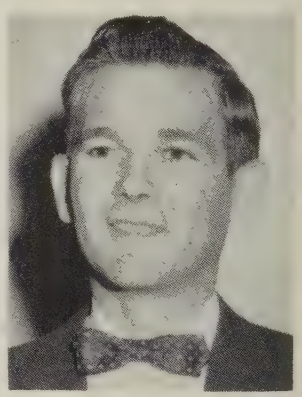
Bulletin GEA-6829 describes a new nationwide instrument rental program established by General Electric through its network of service shops. The eight-page bulletin discusses scope of program and other pertinent factors involving more than 13,000 instruments offered for rent. Available from General Electric Co., Schenectady 5, N. Y.

Terms of purchase of the business, equipment, and one plant of General Electric Co.'s Plastics Department by Haveg Industries, Inc. of Wilmington, Del., have been agreed upon by the two companies. The agreement was announced by John Lux, president of Haveg Industries, and Arthur C. Treece, general manager of the G.E. Plastics Department.

The sale, which includes General Electric's plant in Taunton, Mass., is conditional on Haveg's ability to negotiate an acceptable agreement with the union representing Taunton employees. Also included in the sale is the business and much of the equipment of General Electric's Decatur, Ill. plant. General Electric will retain the physical plant there for anticipated use by another company department. Haveg plans to consolidate it new plastics business in Taunton, with an anticipated increase in the size of that operation.

"Our decision to withdraw from the custom molded plastics business was reached with great reluctance," Mr. Treece said. "It was made only after a critical study and analysis of General Electric's over-all position and opportunity in the molded plastics industry.

"When the Plastics Department was organized in 1931, there was a great need for an organization devoted exclusively to research and development engineering and the manufacture and fabrication of plastics materials and products. At that time it was virtually impossible in the then new and small plastics industry to obtain plastics products vitally needed by General Electric from dependable and effective suppliers backed up with research and engineering. In 1959, this situation no longer exists."



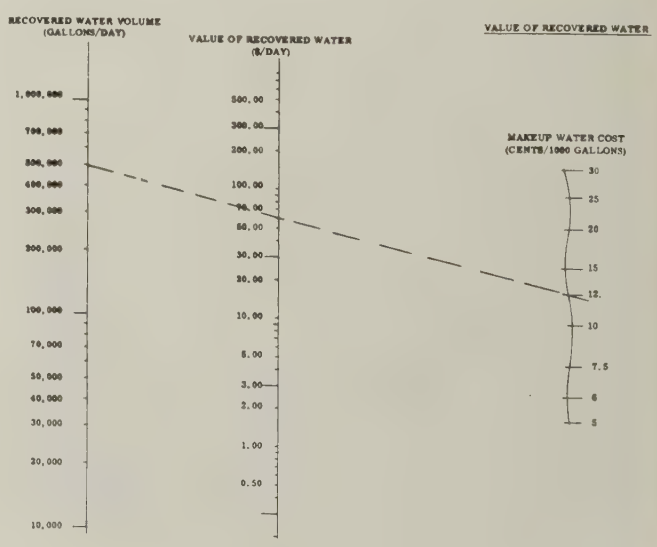
***R. E. Kimball, Graver Tank & Mfg. Co.***

### Graver

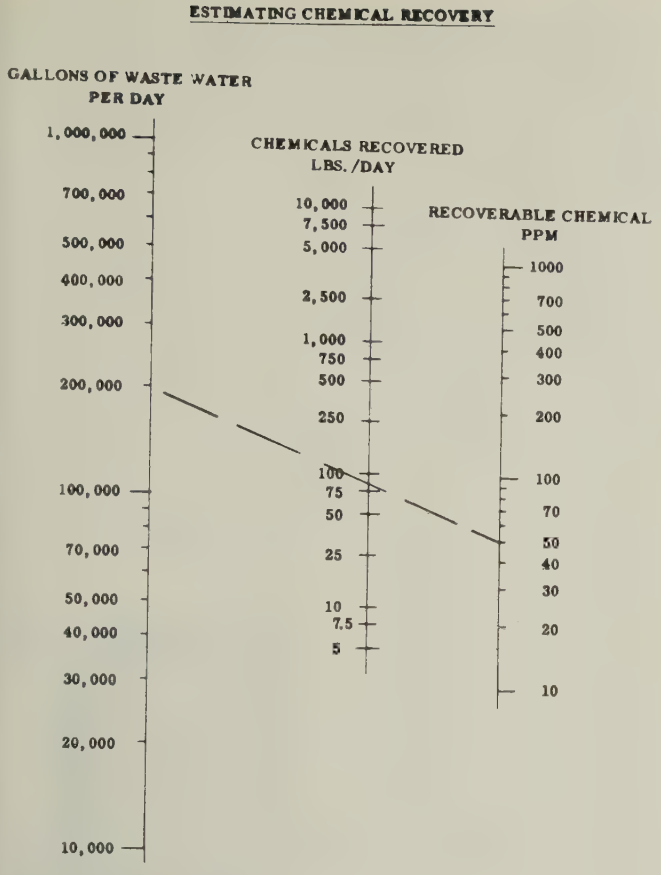
Graver Tank & Mfg. Co., fabricators and erectors of steel and alloy plate since 1857, has announced the opening of a new sales office in Seattle, Wash. Promoted from Graver's East Chicago, Ind. headquarters to head this office is Richard E. Kimball, district sales manager.

Kimball's new headquarters are at 669 White-Henry-Stuart Building, Seattle 1, Wash. His territory covers the states of Washington and Oregon.

Two nomographs—one on the value of recovered water and the other on the amount of waste chemical which can be re-


RECOVERED WATER VOLUME (GALLONS/DAY)
VALUE OF RECOVERED WATER ($/DAY)
VALUE OF RECOVERED WATER
MAKEUP WATER COST (CENTS/1000 GALLONS)

***Value of recovered water***




*Estimating chemical recovery*

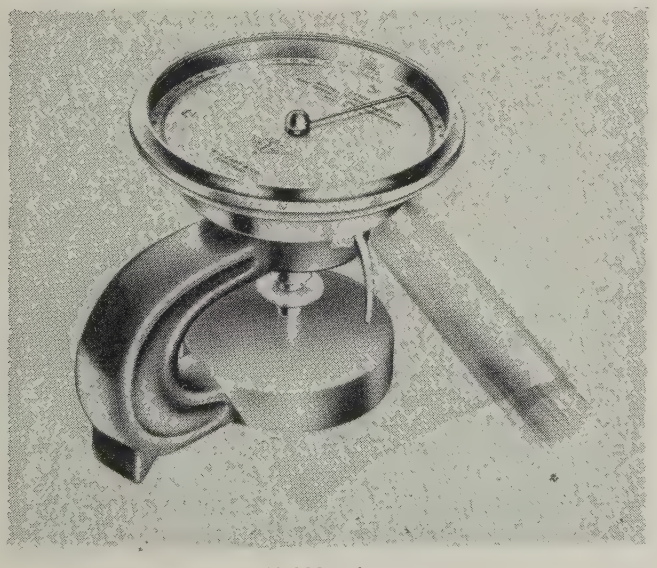
covered—have been released by Graver Water Conditioning Co., 216 West 14th St., New York 11, N. Y. Copies are available on request.

### Cady

For checking or comparing thicknesses where exact readings are necessary, this dial micrometer is graduated in 0.0001 in. with thickness capacity of fifty thousandths.

Named the Cady 10,000 micrometer, it has been developed following requests from makers and users of thin materials: cellophane, polyethylene and other films, laminates, papers, foils, tissues, sheet stock, and coated materials requiring critical thickness measurements.

The 10,000 micrometer is an addition to the line of Cady exact dial micrometers comprising spring action and dead weight models, with graduations in thousandths and half-thousandths of an inch, or hundredths of a millimeter. Manufacturer is E. J. Cady & Co., 630 N. Harlem Ave., River Forest, Ill.



*Cady 10,000 micrometer*

### Hercules

Director of Hercules Powder Co. at their annual reorganization meeting today re-elected all officers of the company as follows: Albert E. Forster, president and chairman of the board; Wyly M. Billing, John J. B. Fulenwider, John R. L. Johnson, Jr., Paul Mayfield, Edward B. Morrow, vice-presidents; J. H. Tyler McConnell, secretary; and John E. Goodman, treasurer.

The directors also re-elected the executive committee: A. E. Forster, chairman; W. M. Billing, J. J. B. Fulenwider, J. R. L. Johnson, Jr., P. Mayfield, and E. B. Morrow.

The board declared a regular quarterly dividend of $1^1/_4\%$, equal to $1.25 a share, on its preferred stock, payable May 15, 1959 to stockholders of record May 1, 1959.

### Metal Hydrides

A new 16-page annotated bibliography, "The Borohydrides in Cellulose and Sugar Chemistry," has been published by Metal Hydrides Inc. It provides a background synopsis of 18 publications on borohydride reductions in cellulose chemistry and 15 in sugar chemistry.

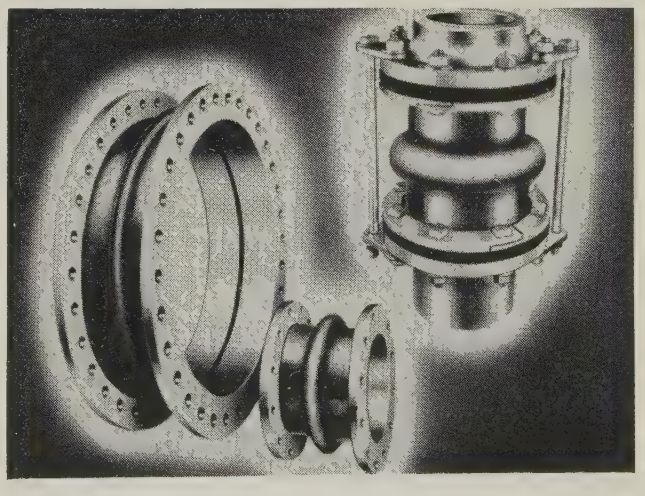
### Ralston Purina

A Special Soy Products Division has been formed by the Ralston Purina Co. as a part of the Soybean Division with Wayne E. Tjossem as its manager, according to an announcement by Eldred A. Cayce, Purina vice-president. Donald B. Walker is director of the Soybean Division.

### Raybestos-Manhattan

Expansion joints for chemical, oil, water or exhaust steam lines, operating at temperature 180 to 200°F., are available from Raybestos-Manhattan in sizes from $^1/_2$ to 78 in. Designed for either pressure or vacuum operation, these joints offer high strength and flexibility necessary to give protection from internal expansion and contraction, vibration, corrosion and erosion and compensate for misalignment. For information and consultation on special engineering problems involving expansion joints, write: Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.

A new brochure is now available from Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J., describing Condor flexible rubber pipe, for use wherever corrosion, abrasion, vibration or thermal expansion would necessitate excessive replacement of conventional pipe. Write: Raybestos-Manhattan, Inc., Manhattan Rubber Division for Bulletin 7152.



*Raybestos-Manhattan expansion joints*

# OBITUARIES

## Erik Bywall

Erik Bywall, mill manager of the pulp and paper mills of Stora Kopparsberg Berglags A/B, Kvarnsvedens, Sweden died recently.

Mr. Bywall was born in Stockholm, Sweden on Oct. 14, 1903 and graduated from the Technical University of Darmstadt, Germany in 1928.

He received his early industry training in the mills of the Anglo-Canadian Pulp & Paper Co., Price Bros Co. and Spruce Falls Pulp and Paper Co., all in Canada. He joined the Stora Kopparsberg organization as an engineer in 1930.

Mr. Bywall became a member of the Technical Association of the Pulp and Paper Industry in 1951.

## C. A. Potter

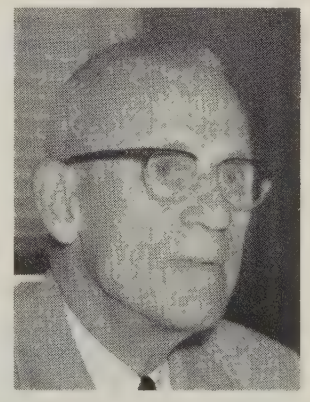
C. A. Potter, 54, vice-president and general manager of B. F. Perkins & Son, Inc., Holyoke, Mass. died suddenly, March 30, 1959 at Northampton, Mass. Mr. Potter started with the company in 1926 as a draftsman in the Engineering Department, resigning in 1944 when he was chief engineer. He rejoined the company in 1953 as general manager.

## Allan Hyer

Allan Hyer, vice-president of Pusey & Jones Corp. died on April 14, 1959 in Wilmington, Del.

Mr. Hyer was born in Philadelphia, Pa. on Sept. 21, 1889. He studied at the University of Cincinnati.

He began his career with the Black-Clawson Co., Hamilton, Ohio, in 1918 as a sales representative. He became sales manager in 1938 and vice-president in 1945. In 1947 he became vice-president and sales manager of Bagley & Sewall Co. in Watertown, N.Y. In 1954 when the Black-Clawson Co. acquired Bagley & Sewall, Mr. Hyer rejoined the Black-Clawson Co. as vice-president. He retired in 1958 and joined the Pusey & Jones Corp. as vice-president.



*Allan Hyer*

During the Second World War Mr. Hyer served on the War Production Board in Washington, D. C. He became a member of the Technical Association of the Pulp and Paper Industry in 1948.

## Frank I. Peterson

Frank I. Peterson, 80, died at Greenwich, Conn., April 11. Widely known specialist in the manufacture of facial and other tissue grades of paper, Mr. Peterson began his long career in the paper industry in Sweden, where he was born.

He was first employed at Fengersfors Paper Mills and later worked for several other Scandanavian paper companies. In 1911 he came to Canada as the first paper mill superintendent of the Wayagamack Kraft Mill, which is now Consolidated Paper Corp. at Three Rivers, Quebec, and one of the earliest of the large sulphate operations in North America. Mr. Peterson was involved in the construction of this mill and spent considerable time at the firm of Bentley & Jackson Ltd. in England during the manufacture of the first two paper machines for the plant.

Moving from Canada to the United States at the end of World War I, Mr. Peterson came to American Writing Paper Corp., Holyoke, Mass. Subsequently he concerned himself mainly with tissue manufacture and was associated with several of the leading producers in the United States.

Mr. Peterson is survived by his son, Frank T. Peterson, President of the Black-Clawson Co.

## John B. Calkin

John B. Calkin, 55, president of Calkin & Bayley, Inc., 50 E. 41st St., industrial consultants, died Saturday, April 18, 1959 at St. Vincent's Hospital. He lived at 4 Washington Mews and at Framingham Center, Mass.

Mr. Calkin had headed the firm since its founding three years ago. Previously he had held positions with three paper companies, Brown Co., Berlin, N. H., Dennison Manufacturing Co., Framingham, Mass., and Union Bag and Paper Corp., with offices in the Woolworth Building. He also served for several years as assistant to the president and director of market research of Foster D. Snell, Inc., New York.

*John B. Calkin*

A member of numerous civic and social organizations, Mr. Calkin was graduated from Haverford College in 1926 and two years later obtained his master's degree at the University of Maine.

Surviving are his wife, Mrs. Ruth Lichty Calkin; a son, William S. Calkin; and three daughters, Mrs. Mary Folsom, Mrs. Hannah Parris and Miss Abigail B. Calkin.

Mr. Calkin has been a member of the Technical Association of the Pulp and Paper Industry since 1927 and was very active in the organization. He was chairman of the New England Section and the Metropolitan District of the Empire State Section as well as serving on several TAPPI committees.

## Lewis Davis

Lewis Davis, 69, retired secretary-treasurer of Davis & Bennett, Inc. died on Feb. 7, 1959 in The Memorial Hospital, Worcester, Mass. Mr. Davis helped found the company in 1923. It is now Davis & Bennett, Inc., Div. of Foster D. Snell, Inc., chemists and bacteriologists.

Mr. Davis was educated at Worcester Polytechnic Institute (B.S. 1911) and Massachusetts Institute of Technology (M.S. 1912). He was a member of Sigma Xi. He was also a member of A.S.T.M., A.I.C., A.A.A.S., A.C.S., S.A.B., A.O.C.S., A.A.T.C.D., and TAPPI. Active in community affairs, he was a member of Worcester County Mechanics Assn., Economic Club, Worcester Torch Club, Natural History Society, Worcester County Music Assn. and a 25-year member of Rotary Club. He was a 32nd degree Mason, a life member of Ashlar Lodge of Detroit, Michigan Consistory and Aleppo Temple Shrine of Boston.

He is survived by his widow, Daisy Davis, a son, Dr. S. Gilbert Davis, and a daughter, Mrs. Myra G. Etsten.

# TAPPI DIVISIONS AND COMMITTEES

*Reports of Activities*

## *Local Section Operations Committee*

The Local Section Operations Committee met Wednesday, Feb. 25, 1959, in Parlor G of the Hotel Commodore, New York, N. Y. Those in attendance were:

A. J. Chase, Maine New Hampshire Section
C. E. Eberly, Indiana District
J. W. Field, TAPPI Staff
W. L. Kite, Kalamazoo Valley Section
W. O. Kroeschell, Kalamazoo Valley Section
R. Leaf, Jr., Lake States Section
R. G. Macdonald, TAPPI Staff
A. W. Morrow, Empire State Section
P. E. Nethercut, TAPPI Staff
E. W. Petrich, Ohio Section
E. E. Stephenson, Jr., Kalamazoo Valley Section
E. W. Strecker, New England Section
J. P. Weidner, TAPPI Executive Committee

R. G. Macdonald presided and called the meeting to order at 4:12 p.m. He introduced the subject of Local Section meeting reports for *Tappi* magazine. At the Joint Advisory Council meeting Sunday the point had been raised that not all Section activities were being reported adequately in *Tappi*. It was decided that the best way to insure complete coverage was to have one person in each Section responsible for writing up all events. Mr. Macdonald noted that all material submitted would be printed in full in *Tappi*.

Mr. Macdonald reported that the petition of the "Associazione Italiana Membri della TAPPI" for local section status had been approved by the Executive Committee and submitted to the Local Section Operations Committee for its approval. The group voted unanimously to accept the Italian group as a TAPPI Local Section on a motion by Mr. Kroeschell. Mr. Stephenson suggested that in the future advance notice be given to the Local Section Operations Committee of such important matters, so that the committee members can coordinate more closely with the Executive Committee on any action taken

John Weidner, representing the Executive Committee, told the committee that the Executive Committee had appointed a subcommittee to review the Association's rebate policy. He was interested in learning how the several Local Sections handled their finances, mailings, and membership requirements. There is a desire that definite policies on dues, rebates on national dues, and geographical boundaries be formulated. He asked for the committee to give some thought to these matters and to comment on the practices of their respective Sections.

Mr. Nethercut stated that the Pacific Section felt that all national TAPPI members living within the geographical area should be considered members of the Local Section for rebate purposes. This posed the question of geographical boundaries. "Who belongs to what Section?" was the question asked by several of the committee. "Is membership in a Local Section defined by participation?" was also asked.

Mr. Stephenson stated that he liked the attitude of the Pacific Section and would like rebates on all national members living within a section's geographical area. He suggested that any area where there might be an overlapping of interest be assigned by the Executive Committee. Mr. Nethercut felt that the decision could be resolved by the Local Section Operations Committee. Mr. Stephenson further commented that the rebate should be given on the basis of all members living in an area since all would get notices of meetings and most of the rebate would be used for direct mail expense.

Mr. Petrich said that the Ohio Section would lose money with a rebate of $2 if it mailed notices to all members in the area. Mr. Strecker felt that the Local Section could bankrupt itself with mailings if it were required to mail these to all national members in its area. Mr. Stephenson suggested mailing only once a year to national members not participating in Section meetings. Mr. Kroeschell questioned the value of direct mail publicity at all. Mr. Petrich felt that the big factor influencing attendance at meetings was distance and said that even with mailings, distant members would find it difficult to come.

Mr. Nethercut stated that presently rebates are given on about 1600 of 7000 national TAPPI members living in the United States. Mr. Weidner said that some felt this was not equitable.

Mr. Petrich thought that rebates should only be given in cases where a member is an expense to the Section with respect to mailings or other activities.

Mr. Weidner stated that rebates were a means of guaranteeing to the Section a certain income each year, but that more uniform rules are needed so that the interests of all Sections are fairly and adequately represented.

The amount of mailing that each Section does should determine its rebates and the adjustment of rebates to suit particular local circumstances is important according to Mr. Eberly. Mr. Leaf felt that rebates should be given only for those national members who are active in Local Section work.

Mr. Petrich moved on behalf of the Ohio Section that no action be taken by the Executive Committee on these matters until the Local Section Operations Committee can make recommendations in light of the experiences of the several Sections. The motion was unanmiously approved.

It was suggested by Mr. Weidner that a questionnaire be prepared by headquarters and submitted to all Local Sections for information on their feelings and practices on the matters of membership, dues, rebates, and geographical boundaries. A copy of each Section's budget would also be requested.

Mr. Stephenson felt that TAPPI Headquarters should assign a full-time man for Local Section work. He suggested having a spring meeting of the committee to discuss all these questions after the questionnaire had been circulated.

Mr. Petrich said that the Section vice-chairman as well as its chairman should attend meetings of the Local Section Committee to provide continuity in its operation. Mr. Morrow suggested that the rebates on members could be used to pay travel expenses for the committee members, if such funds could not be obtained elsewhere. Mr. Leaf felt that all travel expenses should be paid by TAPPI. Mr. Eberly said that in his experience it was implied that a man's company would generally bear these expenses when a Local Section officer was elected and requested permission from his company to accept the post.

Mr. Kroeschell moved that an agenda be prepared well in advance of any Local Section Operations Committee meeting and circulated, so that Local Section officers could consult their membership before coming to a committee meeting. The motion was seconded and adopted unanimously.

Mr. Leaf moved that this committee prepare a recommendation to the Executive Committee on policy concerning rebates and related matters after appropriate consultation on the basis of a letter from headquarters to all Sections outlining the areas of discussion. The motion was passed unanimously.

Mr. Strecker felt that a set of rules was needed for policy purposes, and that these rules should define what was expected of each section and what shape its organization should take. Messrs. Stephenson, Strecker, and Morrow requested that a Headquarters man be assigned to help guide the Sections in their activities.

Mr. Nethercut said that copies of the "Manual for the Guidance and Operation of Local Sections" would be sent out to the committee members, so that they could indicate which portions needed to be expanded, deleted, or otherwise altered.

It was the consensus of the committee that a meeting be held this spring to prepare recommendations on the rebate question. The latter part of April in Pittsburgh was one suggestion.

The meeting was adjourned at 5:15 p.m.

J. W. FIELD, *Acting Secretary*

## *Electrical Engineering Steering Committeee*

The TAPPI Electrical Engineering Committee Steering Committee met at the Hotel Commodore, New York, Feb. 24, 1959. Present were

R. F. Sorenson, *Chairman*
I. M. Witham, *Vice-Chairman*
G. E. Shaad, *Secretary*
M. J. Osborne, *Past Chairman*
M. H. Fisher, *Past Secretary*
M. M. Stokely, *Membership Chairman*
H. O. Teeple, TAPPI

The meeting was convened by Mr. Sorenson at 9:00 a.m. and the following matters of committee interest were discussed.

*Committee Membership.* Mr. Stokely reviewed the list of proposed members and the general policy of adding to subcommittee membership rather than committee membership was discussed. Many of the proposed members were felt to be valuable additions to one or more subcommittees. Mr. Sorenson and Mr. Stokely will contact the individuals and subcommittee chairmen involved.

*Steering Committee Membership.* Since the data sheets are now assigned to the vice-chairman, it was suggested to the chairman that the chairman of the Publicity Committee be included in the Steering Committee. The group would then consist of chairman, vice-chairman, secretary, past-chairman, past-secretary, membership chairman, and publicity chairman.

*Data Sheets.* Mr. Witham distributed a group of data sheets issued by CPPA. These were reviewed but it did not seem desirable to publish duplicate sheets.

A group of existing data sheets under the auspices of the Electrical Committee were reviewed as to their usefulness and accuracy. The following actions were taken:

Data Sheet No. 70. Amperes per Terminal for Motors—Abandon.

Data Sheet No. 73. General Lighting Requirements in Pulp and Paper Mills—Approved as is.

Data Sheets No. 145. A to I Inclusive—Power Requirements for Paper Machines—With the exception of sheets G and I that were revised in 1958, these sheets were referred to Mr. Cundelan's subcommittee on Drive Requirements—Paper Mill.

Data Sheet No. 153—Power Requirements of Mixers was referred to Mr. Herrington's subcommittee on Power Requirements—Pulp Mill.

Mr. Witham will contact the subcommitee chairmen involved.

*Electrical Engineering Steering Committee*

*Projects.* Mr. Sorenson reviewed the status of the following projects:

No. 368—Power Requirements of Supercalenders—Questionnaire in circulation, results unknown, will not be completed for the Pittsburgh meeting.

No. 620—Power Requirements of Pulp Machines—Work proceeding probable preliminary report available for June committee meeting.

No. 621—Power Requirements of Structural Board Machines—Awaiting additional data.

No. 622—Power Requirements of Tissue Machines—Inactive will abandon for the present.

No. 657—A.C. Motor Selection Table—Completed, data sheet in hands of Review Board.

No. 677—Use of Butyl Rubber Cable—Final report in preparation, revision of data sheet to follow.

No. 686—Design Standards for Medium Voltage Control—Data Sheet complete and in hands of Review Board.

No. 739—Motor Application for Centrifugal Pumps—Data Sheet complete and in hands of Review Board.

No. 740—Winder Power Requirements—Preliminary work complete, final report to be presented at Pittsburgh meeting.

No. 746—Power Requirements for Barking Drums—In process but not definitely scheduled.

No. 747—Power Transfer within Wet Felts—Actively proceeding, paper will be presented at Pittsburgh meeting.

No. 748—Electrical Control of Fourdrinier Machine Helper Drives—In process, paper scheduled for presentation at Pittsburgh meeting.

No. 749—Safety in Mill Electrical Work—In process, paper scheduled for presentation at Pittsburgh meeting.

*1959 Interim Meeting.* The 1959 interim meeting of the Electrical Committee is scheduled for the morning of June 17 at Orono, Me., in conjunction with the AIEE Pulp and Paper Conference to be held at the University of Maine on June 18 and 19, 1959.

*1959 Papers at Pittsburgh.* The scheduled papers will consist of the previously scheduled papers on Project No. 748 and No. 749, a paper on Project No. 747 to replace the originally planned paper on Project No. 368, the final report on Project No. 740, and a paper on nonelectronic static excitation systems. It was agreed that Mr. Shaad would arrange for the presentation of the paper on static excitation.

*Proposed Papers for 1960 Engineering Conference.* Suggested papers for 1960 presentation were:

Ventilation of Motor Rooms
Supercalender Power Requirements
Selection of Motors for Refining Operations
Selection of Drives for Washers
Mill Experience with Sealed Motor Insulation Systems

Mr. Sorenson will propose these projects to the appropriate subcommittee chairmen.

*Monograph on Mill Power Systems.* Mr. Teeple suggested that the committee consider the preparation of such a monograph as had originally been planned. Mr. Sorenson will review this item with the subcommittee chairman.

The meeting was adjourned at 12:30 p.m.

G. E. Shaad, *Secretary*

## *Plastics Committee—1958 Annual Report*

### *Business Meetings*

Two business meetings were held during the year.

The first meeting was held on Feb. 17, 1958, at the Hotel Roosevelt, New York, during the Annual TAPPI Meeting. Six members and five nonmembers attended. Attendance was poor due to a snow storm, which delayed arrivals. The various chairmen of subtask groups made progress reports and elections of new officers were made. The following were appointed:

*Chairman,* W. N. Stickel
*Vice-Chairman,* R. C. Sturken
*Secretary,* V. T. Stannett

The second meeting was held on Oct. 20, 1958, at the Sheraton-Kimball Hotel, Springfield, Mass. during the Thirteenth Plastics-Paper Conference. Seven members and 27 nonmembers attended. The various chairman of subgroups made progress reports. Under new business it was voted that the Testing Committee be approached as to the possibility of setting up a subgroup concerned with test methods involving plastic-paper combinations.

### *Subtask Groups*

*Task Group 586*—Properties of Paper Affecting Adhesion of Resin Used in Extrusion Lamination, W. A. Schenck, *chairman.*

A proposed research project was drawn up and presented to the Plastics Committee. Upon approval it was presented to the TAPPI Research Appropriations Committee. The appropriation was denied. This project will be discussed further at the next Plastics Committee business meeting.

*Task Group 585*—Survey of Test Methods for Synthetic Resin in Paper Combinations, J. J. Sullivan, *chairman.*

A complete report was presented covering the results of a questionnaire carried out by this committee on the present testing procedures being used by the trade. The task group was dropped upon completion of this project. The survey will be used to further the quest for a subgroup under the Testing committee concerned specifically with tests for plastic-paper combinations.

*Task Group 587*—Properties of Paper Affecting Adhesion of Resins Applied to Paper from Solutions, Emulsions, or Dispersions, N. Sherwood, *chairman.*

Due to a change in jobs, Mr. Glutting was forced to resign as chairman and Mr. Sherwood replaced him. There have been no reports of progress from this committee during this year.

*Task Group 537*—Research Project No. 73, Permeability of Plastic-Treated Paper to Gases and Liquids, J. J. Uber, *chairman.*

This project is now in its terminal year and the final report will deal in detail with the problem of water vapor transmission through plastic films.

There have been four annual reports submitted to date for the years of 1954, 1955, 1956, and 1957. In addition there was a fifth report submitted in July, 1958, which was published in the October, 1958, issue of *Tappi.*

It is reported that we will be able to have a paper presented at the 1959 TAPPI Plastics-Paper Conference.

### *Plastic Committee Membership*

The present members of the Plastics Committee are shown in the following list:

F. J. Banisch, Lowe Paper Co.
R. E. Benton, Goodyear Tire & Rubber Co.
George L. Booth, Dilts Div., Black-Clawson Co.
R. N. Campen, 6626 Union Ave., Cleveland 5, Ohio
W. P. Costello, Rogers Corp.
J. W. Couture, Dilts Div., Black-Clawson Co.
W. H. Griggs, Eastman Kodak Co.
D. H. Hall, B. F. Goodrich Co.
W. L. Hardy, Foster D. Snell, Inc.
R. G. Hochschild, Koppers Company, Inc.
T. A. Howells, Institute of Paper Chemistry
F. R. Lehman, Institute of Paper Chemistry, Coatings Technical Service
Richard W. Loheed, Charles T. Main, Inc.
P. J. McLaughlin, Research Division, Rohm & Haas Co.
H. G. Maeder, Jr., Dixie Cup Div. of American Can Co.
R. H. Mosher, Research Engineer, Kimberly Clark Corp.
E. J. Paxton, Jr., Robert Gair Div., Continental Can Co.
J. C. Pullman, American Cyanamid Co.
Fred R. Ramage, Latex Fibers Ind., Inc.
R. W. Reiter, National Starch Prod., Inc.
R. H. Reuther, Scott Paper Co.
Fritz Rosenthal, Knowlton Brothers
A. W. Schenck, Riegel Paper Corp.
N. Sherwood, B. F. Goodrich Co.
V. T. Stannett, College of Forestry, State University of New York
Wesley N. Stickel, Texon, Inc.
Robert C. Sturken, Frank W. Egan & Co.
J. J. Uber, Plastic Coating Corp.
B. R. Whaley, Sonoco Products Co.
G. W. Wright, Nashua Corp.
W. Zembal, Dow Chemical Co.

W. N. Stickel, *Chairman*

## *Plastics Committee*

A meeting of the Plastics Committee was held at the Commodore Hotel in New York, on Monday, February 23, at 2:00 p.m. during the TAPPI Annual Meeting. The following members and guests were present:

F. J. Banisch, Lowe Paper Co., Ridgefield, N. J.
R. E. Benton, Goodyear Tire & Rubber Co., Akron, Ohio
J. W. Couture, Black-Clawson Co., Fulton, N. Y.
*W. P. Dohne, Dixie Cup Div., American Can Co., Easton, Pa.
*S. M. Kline, Koppers Co., Inc.
R. W. Loheed, Chas. T. Main Inc., Boston, Mass.
P. J. McLaughlin, Rohm & Haas Co., Philadelphia, Pa.
H. G. Maeder, Dixie Cup Div., American Can Co., Easton, Pa.
*R. W. Morgan, Dow Chemical Co., Midland, Mich.
E. G. Paxton, Jr., Robert Gair Div. Continental Can Co., Norwich, Conn.
F. R. Ramage, Latex Fiber Ind., Inc., Beaver Falls, N. Y.
*A. G. Richards, Bjorksten Research Lab., Madison, Wis.
F. Rosenthal, Knowlton Bros. Inc., Watertown, N. Y.
A. W. Schenck, Riegel Paper Corp., Milford, N. J.
W. N. Stickel, *Chairman,* Texon, Inc., South Hadley Falls, Mass.
R. C. Sturken, Frank W. Egan & Co., Somerville, N. J.
*J. J. Taylor, Semet Solvay-Allied Chemical Corp.,
M. W. Zembal, Dow Chemical Co., Midland, Mich.
W. L. Hardy, International Minerals & Chemicals Corp.

The minutes of the previous Plastics Committee meeting were read and accepted. This was followed by general discussions and subcommittee reports as covered below.

*14th Annual Plastics-Paper Conference—W. L. Hardy, conference chairman.*

Mr. Hardy presented a suggested program for the conference and received additional suggestions from the members.

*Progress Report*—Permeability of Plastic Films and Treated Paper to Gases and Vapors—J. J. Uber, *chairman,* Steering Committee.

References: Grant No. 89 (1956) $7400
Grant 120 (1957) $2200
Grant 149 (1958) $2400

* Guests.

*Plastics Committee*

1. To date the following written reports have been submitted from the State University College of Forestry:

Annual Report—Period Dec. 1, 1953, to Nov. 30, 1954, dated Jan. 28, 1955.
Annual Report—Period Dec. 1, 1954, to Nov. 30, 1955, dated Dec. 22, 1955.
Annual Report—Period Dec. 1, 1955, to Nov. 30, 1956, dated Dec. 12, 1956.
Annual Report—Period Dec. 1, 1956, to Nov. 30, 1957, dated Dec. 22, 1957.
Report Part V—Supplement to previous annual report—July 29, 1958.

2. On July 29, 1958, V. T. Stannett accompanied the last report with a letter, which included the following statement:

"The project is now in its terminal year and the final report (and manuscript) will deal in detail with the problem of water vapor transmission through plastic films. It is highly probable that we will be able to present a paper on this problem at the Fall 1959 TAPPI Paper-Plastics Conference which will be shortly after my return from Europe."

3. M. Szwarc, who is in charge of the project during Mr. Stannett's absence, was contacted and he informed us that a progress report from the college would be impossible at this time since Mr. Stannett has most of the information in Europe

A brief report covering Project No. 586, "Properties of Paper Affecting Adhesion of Extruded Resins," was presented by A. Schenck, chairman of this task group. Reasons for rejection of the project were discussed and it was voted by the committee that this task group should continue with this project—revising it so that it would be acceptable for resubmission to the Research Appropriations Committee.

Messrs. Benton, Sturken, and Schenck were appointed as nominating committee for the officers of secretary and vice-chairman. The names of R. W. Loheed for vice-chairman and R. E. Benton for secretary were presented and accepted. The meeting continued with a general discussion and the following report was made:

"On May 21, 1959, the Eastern District of Empire State Section of TAPPI is sponsoring a one-day symposium on "Beater Additives." This will be the Fourth Annual Symposium sponsored by the Eastern District."

The symposium will be held at the Queensbury Hotel in Glens Falls, N. Y., with the technical session starting at 2:00 p.m. This technical session will consist of the following:

"Elastomers," Neil H. Sherwood, B. F. Goodrich Chemical Co.
"Phenolics," Robert Gager, Synco Resins Inc.
"Resins, Wet and Dry Strength," J. C. Barthel, American Cyanamid Co.
"Starches and Gums," Arthur M. Goldstein, Stein Hall & Co.
"Mill Practices," Fred R. Ramage, Latex Fiber Industries, Inc.

These men will give about a 20 minute talk on their assigned topics and then sit as a panel to answer and discuss questions from the floor. Vince A. Long, of the Blandy Paper Co., will be moderater for this group.

If anyone plans to attend the above symposium, please advise Paul L. Page, Eastern District, Empire State Section TAPPI.

*Tank Project No. 587.* "Properties of Paper Affecting adhesion of Resins Applied to Paper from Solutions, Emulsions or Dispersions." After a general discussion of this subject it was suggested, due to the wide scope of this project and to the inability to attain funds for the preceding task group, that it be dropped. This motion was made and approved.

W. N. Stickel, *Chairman*

## *Mechanical Pulping Committee*

A meeting of the Mechanical Pulping Committee was held at the Commodore Hotel, New York, N. Y., Feb. 25, 1959, with the following attendance:

A. A. Yankowski, *Chairman*, Kimberly-Clark Corp., Neenah, Wis.
J. K. Kirkpatrick, *First Vice-Chairman*, Bowaters Southern Paper Corp., Calhoun, Tenn.
J. H. Perry, *Secretary*, Norton Co., Worcester, Mass.
J. H. White, *Liaison Officer*, Keyes Fibre Co., Waterville, Me.
F. W. O'Neil, New York State College of Forestry, Syracuse, N. Y.
Maung Shwe Htoo, International Paper Co., Glens Falls, N. Y.
W. H. Copeland, Norton Co. of Canada, Ltd., Hamilton, Ont.
F. W. Lorey, New York State College of Forestry, Syracuse, N. Y.
Piero Bersano, Cartiere Burgo, Turin, Italy
K. L. Pingrey, Diamond Gardner Corp., Ogdensburg, N. Y.
J. P. Corbin, St. Regis Paper Co., Jacksonville, Fla.
Thomas Gerace, St. Regis Paper Co., Sartall, Minn.
E. H. Johnson, Stevens & Thompson Paper Co., Greenwich, N. Y.
S. R. Parsons, Consolidated Water Power and Paper Co., Wisconsin Rapids, Wis.
A. J. Winchester, TAPPI, New York, N. Y.

### *Current Business*

Mr. Yanowski opened the meeting promptly at 9:00 a.m. He complimented the group for the large attendance and then requested the secretary to read the minutes of the last meeting of Sept. 9, 1958. Upon motion of J. K. Kirkpatrick the minutes were accepted as read with the exception that only single mailing of the questionnaire be submitted rather than second mailing as recorded on page 4, second paragraph. Due to this error, the third paragraph is unnecesssary and is stricken from the records.

The chairman of each project reported in detail on his respective responsibilities as noted below;

*Project No. 636.* Effect of Underwater Storage of Pulpwood on Groundwood Brightness. Karl E. Pingrey, *chairman.*

Mr. Pingrey submitted his second interim report of this project. It will be noted that the data obtained are the results of two years work. Mr. Pingrey gratefully acknowledged the assistance of J. F. Jahne of the New York State College of Forestry. This phase of the project will continue until the wood samples are exhausted.

A second report on this project was submitted by S. R. Parsons. This report concludes the efforts of Mr. Parsons on his phase of the project as the wood samples have all been used.

Piero Bersano reports increase in brightness from 63 to 69 at the end of six months of underwater storage. The brightness of air-stored wood dropped to 58. He observed that the physical properties of the pulp declined. He suggested that a water analysis be conducted, as it is his opinion that the water composition has an important bearing on results.

J. H. White has observed that wood cut during the peeling season loses brightness immediately following the peeling

*Mechanical Pulping Committee*

season, that is, in the early fall. He further observed that dry rot developed rapidly in the cambium area. Wood cut after the peeling season does not tend to develop this rot until the next peeling season. All of this applied to rough wood only.

*Project No. 678.* The Effect of Closed White Water System on Groundwood Brightness. F. W. O'Neil, *chairman.*

F. W. O'Neil reported he has received TAPPI Grant No. 162, permitting him to use up to $600 for this project. He will procure water samples through the courtesy of Keyes Fibre Co., these samples to be obtained from a closed system, an open system, and fresh water. He will also procure pulp samples from the same source. It is his intention also to do an approximate water analysis.

*Project No. 680.* A Survey of Groundwood Mill Process Instrumentation. J. K. Kirkpatrick, *chairman.* D. S. Burak, former chairman of this committee, has resigned and Mr. Kirkpatrick was assigned the chairmanship by A. A. Yankowski. There was no report on this project. Mr. Kirkpatrick will select committee personnel and will continue the project.

*Project No. 591.* Groundwood Manual. E. H. Johnson, *chairman.* E. H. Johnson proposed that the material now at hand be submitted to various committee members for editing. He remarked that some chapters should be revised so that they will be slanted to the groundwood operator's viewpoint. Mr. Yankowski suggested that he and S. R. Parsons could work together, making a preliminary editing. Mr. Johnson agreed to this and will forward all material to Mr. Yankowski. It was his opinion that at the next meeting of the committee this manual should be about ready for printing.

*Project No. 637.* Study of Groundwood Wet Web Strength. Maung Htoo, *chairman.* This project has been completed and has been published as TAPPI Special Report No. 427. This report was issued on schedule Jan. 15, 1959. Maung Htoo reported some minor typographical errors, and has since mailed a letter containing the corrections to all members. Maung Htoo gratefully acknowledged the very able contributions of Roy Illingsworth of Great Northern Paper Co. A motion was made by Karl Pingrey, seconded by Keith Kirkpatrick, and carried by acclamation, that Muang Htoo has done an outstanding job in bringing this project to a most successful conclusion. Muang Htoo made a motion that the special report be referred to the TAPPI Testing Committee. This was seconded by John White and carried.

J. H. White was appointed chairman of the subcommittees whose function will be to keep abreast of developments in the groundwood industry, principally groundwood produced by other than conventional means. He will contact W. H. de Montmorency of the CPPA Mechanical Pulping Committee.

A letter was read from Neil F. Robertson in which he has submitted his resignation as second vice-chairman of the committee. He felt, in fairness to the committee, that his duties as manager of West Tacoma Newsprint Co., and as a director of this company, would conflict with the committee meetings and that as a consequence he could not be sure to be able to attend scheduled meetings. He will continue to be a member of the committee. The motion was made by Karl Pingrey, and seconded by Keith Kirkpatrick to accept Mr. Robertson's request to be relieved of the office, and before the motion was carried. There was much discussion and comment from the committee, complimenting Mr. Robertson on his faithful attendance at committee meetings and the other fine work he has done to further the work of the committee. Regret was expressed that we would not have the benefit of Mr. Robertson's services as an officer of the committee.

A letter was read from John D. Moore of the Sealright Co., Inc., in which he tendered his resignation as a member of the committee. Mr. Moore regrets that this move is necessary, but points out that in his new position he is not associated with the manufacture of mechanical pulp and that his present duties do not permit him to be away from the mill. He asked that his kindest personal regards be extended to all members. A motion was made, seconded, and carried, and the committee regretfully accepted.

Mr. Yankowski introduced a motion to accept the resignation of D. S. Burak who had telephoned him that his present duties did not permit further committee activities. He regrets that this move is necessary, but offered to help if at any time he can be of service. Mr. Burak's resignation was regretfully accepted and mention was made that this move was a distinct loss to the committee.

A motion was introduced by F. W. O'Neil that a temporary elective committee be appointed to nominate candidates to fill the offices of first vice-chairman and second vice-chairman. This was seconded by J. H. White and carried. A nominating committee composed of F. W. O'Neil, J. H. White, and A. A. Yankowski was appointed. They retired from the meeting for a few minutes and then returned, placing the name of S. R. Parsons in nomination for the first vice-chairmanship and Maung Htoo for the second vice-chairmanship. The committee then voted and unanimously elected these two gentlemen to office. Mr. Yankowski then turned over the chairmanship to J. K. Kirkpatrick as established in the bylaws. The office of second vice-chairman was an issue at this time because of the withdrawal of N. F. Robertson. A. A. Yankowski, the retiring chairman, now becomes liaison officer, according to the bylaws. J. H. Perry was again unanimously elected to the post of secretary.

Mr. Kirkpatrick then assumed the Chair and gave a report on the Third International Mechanical Pulping Conference at Quebec. He first commended all those who took part in the Conference, both in offices, and by participating in the programs. The Conference was a success financially, as a small bank balance remained after all obligations were satisfied. The technical program was considered successful also, because all members reported that they had received most favorable comments from those in attendance. Mr. Kirkpatrick also expressed grateful appreciation of the part played by the Mechanical Pulping Committee of the Technical Section of CPPA. J. H. White presented the motion that all members of the Third International Mechanical Pulping Committee be accorded by TAPPI headquarters an appropriate recognition of their efforts on behalf of the conference. This was seconded by Mr. Johnson and carried.

There was considerable discussion regarding the Fourth Mechanical Pulping Conference. It was agreed that a fourth conference will be held within three years from the last one, and on this basis the Fourth Mechanical Pulping Conference is tentatively scheduled for the fall of 1961 in Chicago, Ill. This action was prompted in part by the fact that a great majority of the delegates who attended the conference recommended that such be the case. All members present

were of the opinion that sufficient new material would be available to formulate a program of value to the groundwood industry. A committee will be formed to work with the CPPA Technical Section to insure that the fourth Mechanical Pulping Conference will be successful. The next meeting of this committee is tentatively scheduled for May 14 at TAPPI headquarters in New York.*

The meeting officially adjourned at 12:30 p.m. but some members continued discussion regarding the fourth conference in the afternoon.

J. H. PERRY, *Secretary*

## *Dissolving Pulp Committee*

The Dissolving Pulp Committee met at the Hotel Commodore, New York, Feb. 24, 1959, 2:00 p.m.

The following members and guests were present:

E. S. McColley, Celanese Corp. of America, Cumberland, Md.
M. A. Millett, Forest Products Laboratory, Madison, Wis.
F. R. Charles, Industrial Cellulose Research, Ltd., Hawkesbury, Ont.
F. Walker, American Enka, Enka, N. C.
M. A. Heath, Buckeye Cellulose Corp., Memphis, Tenn.
E. Kline, Industrial Rayon Corp., Cleveland, Ohio
F. L. Wells, Eastman Kodak Co., Rochester, N. Y.
M. M. Cruz, American Viscose Corp., Marcus Hook, Pa.
R. W. Swinehart, The Dow Chemical Co., Midland, Mich.
E. J. Howard, Industrial Cellulose Research, Ltd., Hawkesbury, Ont.
F. A. Simmonds, Forest Products Laboratory, Madison, Wis.
T. F. Clark, Northern Regional Lab., Peoria, Ill.
T. L. Kirtley, Hercules Powder Co., Hopewell, Va.
H. D. Partridge, Brown Co., Berlin, N. H.
J. F. Saeman, Forest Products Lab., Madison, Wis.
M. Plunguian, Hercules Powder Co., Wilmington, Del.

### *Election of Officers*

The following were elected officers for 1959:

M. A. Heath, Buckeye Cellulose Corp., *Chairman*
E. J. Howard, Industrial Cellulose Research Ltd., *Vice-Chairman*
M. Plunguian, Hercules Powder Co., *Secretary*

### *Membership*

The current membership is as follows:

T. F. Clark, Northern Utilization Research Branch, Peoria, Ill.
M. M. Cruz, American Viscose Corp., Marcus Hook, Pa.
D. F. Durso, Buckeye Cellulose Corp., Memphis, Tenn.
M. A. Heath., *Chairman*, Buckeye Cellulose Corp., Memphis, Tenn.
E. J. Howard, *Vice-Chairman*, Industrial Cellulose Research, Ltd., Hawkesbury, Ont., Can.
T. L. Kirtley, Hercules Powder Co., Hopewell, Va.
E. Kline, Industrial Rayon Corp., Cleveland, Ohio
R. H. MacClaren, Eastman Kodak Co., Rochester, N. Y.
F. J. Masuelli, Picatinny Arsenal, Dover, N. J.
E. S. McColley, Celanese Corp. of America, Cumberland, Md.
F. K. Mesek, Johnson and Johnson, Chicago, Ill.
M. A. Millett, Forest Products Laboratory, Madison, Wis.
H. DeV. Partridge, Brown Co., Berlin, N. H.
L. N. Rogers, The Buckeye Cellulose Corp., Memphis, Tenn.
J. F. Saeman, Forest Products Laboratory, Madison, Wis.
M. O. Schur, Ecusta Paper Corp., Pisgah Forest, N. C.
F. A. Simmonds, Forest Products Lab., Madion, Wis.
J. J. Spadaro, Southern Utilization Research Branch, New Orleans, La.
R. W. Swinehart, The Dow Chemical Co., Midland, Mich.
F. Walker, American Enka Corp., Enka, N. C.
M. Wayman, Columbia Cellulose Co., Ltd., Prince Rupert, B. C., Can.
K. Ward, Jr., The Institute of Paper Chemistry, Appleton, Wis.

The papers of the preceding day in the dissolving pulp sessions were well received.

A lively discussion ensued about the last paper "Outline for a Basic Study of the Differences between Cotton Linters and Wood Pulps" and the possibility of sponsoring a TAPPI research project on a portion of this study. It had been brought out at the meeting that some years ago a series of rayons could be identified by x-ray methods as to their wood pulp or cotton linters origin. Would this be true of present day commercial rayons? Such a study could lend itself readily to an academic research project. It was also proposed to sponsor a study of morphological differences between cotton linters and dissolving grade wood pulps, such as by x-ray, electron microscopy, and every other modern tool.

*Dissolving Pulp Committee*

It is not a TAPPI requirement to sponsor a project and it may be difficult to obtain the endorsement at this time. M. A. Heath will undertake preliminary investigations before considering the submission of a proposal.

The greatest service of this committee should continue to be to sponsor programs for the national meetings. Cooperation with ASTM on end-use tests is also very important.

### *Plans for Future Meetings*

A letter was received from D. J. MacLaurin, secretary of the Pulp Purification Committee, proposing a joint 2-day conference in 1960, at some point other than New York. After some discussion, it was moved, seconded, and carried that the committee secretary inform the Pulp Purification Committee that we consider it impractical to undertake a separate meeting away from the annual New York meeting, and that we prefer to hold our meetings during the regular New York TAPPI week.

For the 1960 meeting, it was decided to plan for one session (of three papers) on viscose and another session on acetate. For the following year (1961), a full day on cellulosics in plastics will be sponsored. Particularly active at this time is the subject of graft polymer formation with cheap monomers. By the following year it may be possible to obtain general papers in this field.

### *Subcommittees*

The need for standing subcommittees was questioned. They only function when there is a definite need for them. Then why not set them up, at the discretion of the chairman, as such need arises? No decision was made on this question

The meeting adjourned at 4:45 p.m.

M. PLUNGUIAN, *Secretary*

## *Structural Fibrous Materials Committee*

The annual meeting of the Structural Fibrous Materials Committee was held in the Hotel Commodore, New York, Feb. 25, 1959. Subcommittee reports were presented and business transacted as reported below.

* Meeting date subsequently changed to May 28, TAPPI Headquarters, New York.

The minutes of the February, 1958, meeting were read. The motion to adopt them as read was carried. In attendance at the meeting were the following:

| | Member of Committee | Member of TAPPI |
|---|---|---|
| R. G. Lacey, Celotex Corp. | X | X |
| A. H. Chamberlain, Bird and Son, Inc. | X | X |
| E. J. Reichman, Simpson Timber Co. | X | X |
| R. D. Fels, Donnacona Paper Co., Ltd. | .. | X |
| C. Allen, Southern Pine Lumber Co. | .. | X |
| L. E. Eberhardt, Bauer Brothers Co. | X | X |
| M. J. Lessard, International Fibre Board, Ltd. | X | X |
| J. P. Hartley, Building Products, Ltd. | .. | X |
| E. M. Jenkins, Johns-Manville | X | X |
| R. A. LaCrosse, Insulation Board Institute | X | X |
| H. L. Becher, Homasote Co. | X | X |
| W. H. McPherson, Minnesota and Ontario Paper Co. | X | X |
| B. A. Jayne, Washington State College | .. | X |
| W. M. McNeal, Bauer Brothers Co. | .. | .. |
| R. H. Neisel, Johns-Manville | X | X |
| W. A. Chilson, U. S. Forest Products Laboratory | .. | X |

### *S-1. New Projects and Review*

Everett Reichman was appointed chairman of this committee.

### *S-2. Papers and Publications*

Chairman Jenkins reported that it is necesary to request papers for the Annual Meeting in September with November 30 being the absolute deadline because of the difficulties encountered in the past in meeting the TAPPI deadline. Mr. Lacey requested that copies of the papers to be distributed to the membership at or before presentation. Mr Jenkins agreed to distribute them if time permits. All papers must clear through subcommittee S-2. Those wishing to submit papers should contact SFMC Chairman von Hazmburg, or the S-2 chairman.

### *S-3. Test Board Formation*

Chairman Lacey referred to his letter of Jan. 30, 1959, concerning the status of the test forming equipment. He reported that the equipment procured by a TAPPI Research Grant has been evaluated and is in use at Celotex and the Forest Products Laboratory. Although many others have expressed interest in evaluation of the equipment and the equipment has been shipped to most of them, various conditions have arisen resulting in no evaluation experiments being performed. The equipment is now at the Mando Paper Co. but is in rather poor shape, needing rehabilitation.

Chairman Lacey advised rehabilitation and sale, Mr. Reichman suggested sale of the equipment as is. Mr. Allen agreed to get information on its possible use at the Southern Pine Lumber Co. plant. Finally, it was agreed that Chairman Lacey would ask for funds for rehabilitation and further shipment and evaluation.

### *S-4. Drainage Time Testing*

Chairman Jenkins reported that favorable results had been obtained from the majority of people evaluating the two testers. Three more evaluations are due this year. The testers are now made by Williams and the Thwing-Albert Co. TAPPI Suggested Method T 1002 sm-56 is now in effect. He suggested that we ask for advancement of the method to a tentative standard. He recommended that we ask TAPPI for an additional $250 for additional shipping expense.

Mr. Reichman moved that a request be made to advance the method to a Tentative Standard. This motion was seconded and carried. It was agreed that steps would be taken to get the additional funds from TAPPI.

### *S-6. Water Absorption, Water Penetration*

Chairman Ziegler was not present and R. S. von Hazmburg reported in his place. The request for a TAPPI appropriation for construction of two water vapor permeability testers was rejected. It was recommended that the request to TAPPI be amplified with the feeling that if this were done the objections would probably be withdrawn. It was also suggested that $1,500 be requested for this project for the construction of either one or two testers depending on costs. Mr. Jayne, from Washington State, believed that it may be possible to construct two testers for the $1500.

The request for a TAPPI grant for a water absorption study at Washington State College was also rejected by TAPPI. It was decided to hold action on this matter in abeyance.

***Structural Fibrous Materials Committee***

### *S-7. Nail Holding and Racking Tests*

Chairman Neisel read his letter of February 13 which served as an annual report of subcommittee 7.

"Negotiations concerning the additional nail holding and racking tests have dragged considerably. I have just received a final quotation on an amended program from Forest Products Laboratory.

"The complete story is:

"For the program outlined in the February, 1959, Committee report and mine of April 23, 1958, to FPL the cost would be $5500.

"For a program as amended to the following in mine of Aug. 13, 1958, to FPL:

9 racking tests
20 lateral nail tests from each racking panel
10 from panel edges at speed of $^1/_4$ i.p.m.
10 from panel interior at speed of 2 i.p.m.—$4000

"This is a considerable increase over the $2400 paid for the first test series but is stated to represent increased costs at FPL. In fact, the figure has been reduced $1000 because of the allowance for lateral nail tests at $^1/_4$ i.p.m.

"The question remains: Is the program worth $4000 to SFMC and will TAPPI approve a research grant in that amount?"

Mr. Jenkins moved that IBI be requested to assume one-half of the cost of this project. Mr. LaCrosse agreed that this should be possible. Chairman Neisel agreed to send complete data to Mr. LaCrosse.

### *S-8. Light Reflection Measurement*

In the absence of Chairman Scott, Mr. von Hazmburg reported. The equipment is very complex (Baumgartner sphere) and appears to have no advantage over several less expensive and less complicated units. The SFMC secretary is requested to get a report on this unit and further plans for it from Chairman Scott.

*S-9. Consistency Measurements of Insulating Board Pulp*

Chairman Chamberlain reported that a method had been drawn up according to TAPPI rules and sent to the TAPPI Standards Committee. TAPPI Standards Committee rejected it on the basis that it would be covered in a method being prepared by the Pulp Testing Committee. However, it appears that some further consideration is being given to the method as Mr. von Hazmburg reported that Mr. Clark has agreed to review the whole matter again.

*S-10. Rate of Drying of Insulating Board*

Chairman Eberhardt was forced to leave the meeting before the discussion started but was represented by Mr. McCord of Bauer Brothers. He reported that the Simpson Logging Co. had been using a test drier for some time and were willing to present information on it for the use of the Structural Fibrous Materials Committee. Mr Reichman described the information and results obtained with the unit. He presented diagrams of the proposed test setup. A means for control of temperature and uniformity was described. Estimated cost of the equipment is $750. It was agreed that Chairman Eberhardt would submit a description of the equipment to members for obtaining their views.

*New Business*

Chairman von Hazmburg stressed the need for new projects inasmuch as the work on several of the old projects appeared to be drawing to a close. He asked for the views of the entire membership and it was agreed that the secretary would correspond with the entire membership on this matter. It was agreed that the Steering Committee, comprising Messrs. von Hazmburg, Neisel, Perot, and McPherson, would meet early in the summer to discuss this matter further and to try to stimulate more activity in the Structural Fibrous Materials Committee.

*Election of Officers*

The following officers were elected by unanimous vote: R. H. von Hazmburg, *chairman,* and W. H. McPherson, *secretary.*

The membership of the Structural Fibrous Materials Committee is now as follows:

R. S. von Hazmburg, chairman, U. S. Gypsum Co.
W. H. McPherson, secretary, Minnesota and Ontario Paper Co.
H. L. Becher, Homasote Co.
J. F. Campbell, Barrett Division, Allied Chemical and Dye Corp.
A. H. Chamberlain, Bird and Son, Inc.
G. H. Chidester, Forest Products Laboratory
J. W. Church, Building Products, Ltd.
E. Frederick, Jr., The Celotex Co.
D. L. Gleaves, Southern Pine Lumber Co.
E. M. Jenkins, Johns-Manville Research Center
R. G. Lacey, The Celotex Corp.
R. A. LaCrosse, Insulation Board Institute
M. J. Lessard, International Fiberboard, Ltd.
W. D. MacKinnon, Donnacona Paper Co., Ltd.
W. J. Marshall, Kaiser Firtex
W. H. McPherson, Minnesota and Ontario Paper Co.
T. R. Naffziger, Northern Regional Research Lab.
J. J. Perot, National Gypsum Co.
E. Reichman, Simpson Timber Co.
W. L. Scott, Armstrong Cork Co.
R. J. Shouvlin, Bauer Brothers Co.
G. W. Thomas, Wood Conversion Co.

Respectfully submitted:
W. H. McPherson
R. H. Neisel

## *Beater Additions Committee*

A meeting of the Beater Additives Committee was held Feb. 24, 1959, at the Hotel Commodore, New York, N. Y., with the following members present: F. S. Klein, J. P. Bainbridge, Jr., J. W. Swanson, J. C. Barthel, H. W. Bartlett, M. L. Cushing, R. B. Porter, E. M. Lorenzini, T. S. Morse, R. W. Kumler, and Miss R. M. K. Cobb.

*Beater Additives Committee*

While the discussion was concerned mainly with the Sizing Monograph, some attention was given to possible other projects for the committee. The consensus was that it was preferable to progress further with the monograph before undertaking other projects. The feeling was that eventually the activities of the committee should be broadened.

J. W. Swanson presented a draft of his section of the monograph entitled, "Surface Chemical Aspects of Paper Sizing." The discussion in his paper had to do primarily with the mechanics of the penetration of water into paper. No detailed discussion of the text was undertaken since the committee members had not seen it prior to the meeting. It was agreed that the copies would be distributed to the members of the committee and that they should be asked to make their comments in writing to the chairman. The chairman would like to take the liberty of commenting that this manuscript, which is essentially a written version of the talk given by Mr. Swanson before TAPPI in February, 1958, represents forward thinking and is a distinct contribution to the technology of the sizing of paper.

Much of the time of the meeting was given to a detailed review of the section on the "Testing of Paper," by R. W. Kumler. The text was gone over bit by bit and many constructive criticisms offered. However, before this was finished it was obvious that there would not be time to complete the review and it was decided that criticisms on this section should also be made in writing. It is, therefore, requested that each committee member write to the chairman his comments regarding this section. They cannot be too frank.

Reports were received from various committee members on the writing of other sections. Mr. Bainbridge advised that his manuscript on aluminum compounds would be ready soon; T. S. Morse for rosin and rosin size; R. B. Porter for wax sizes; Mr. Lorenzini for asphalt size; Mr. Bartlett and Mr. Barthel for special sizes; all would have manuscripts available within the next few months. R. G. Mispley, who has the section on mill factors affecting sizing, was not present to report, but the chairman will get in touch with him. Mr. Swanson will supply a section on the theoretical aspects of the sizing process itself.

No definite plans were made for the next meeting, but when more manuscripts are received the chairman will poll the members to determine the feasibility of holding a midyear meeting of the committee.

R. W. Kumler, *Chairman*

## *Microbiological Committee*

A meeting of the Microbiological Committee was held at the Commodore Hotel, New York, N. Y., Feb. 23, 1959, with the following members present: R. F. Drescher, Buckman Laboratories, Inc., C. G. Humiston, Dow Chemical Co.. G. R. Hunt, Jr., National Aluminate Co., B. F. Shema, W. H. and L. D. Betz, Inc., A. M. Stern, West Virginia Pulp & Paper Co., W. M. Van Horn, Institute of Paper Chemistry, R. S. Williams, R. T. Vanderbilt Co., Inc. M. Legator, Shell Development Co., was present as a guest.

The committee meeting was called to order at 2:00 p.m. by W. M. Van Horn, *chairman.*

R. S. Williams nominated R. F. Drescher for secretary and the nomination was seconded by W. M. Van Horn. The motion was made, seconded and carried that nominations be closed.

#### *Current Status of Standard Methods under Jurisdiction of the Committee*

The upgrading of the TAPPI Standard Method T 487 m-54 which deals with mold resistance of paper and paperboard, from a tentative to an official listing, was discussed. The delay in submitting the method may be attributed to attempts to develop a common method cooperatively with ASTM. Because there has been no reply to our proposals from Commitee D-6 of the ASTM since March 31, 1958, it was decided that our committee efforts regarding Method T 487 m-54 should proceed independently of ASTM.

The TAPPI Standard Method T 487 m-54 also incorporates the spore cloud method of L. J. Vinson [*Tappi* 36, No. 5: 234–236 (May, 1953)]. It was decided that L. J. Vinson should be contacted relative to improvements in his method prior to sending method T 487 m-54 to the Standards Committee. B. F. Shema will follow through on this and advise the members of the committee of any changes. Comments of the committee members relative to any changes should be sent to B. F. Shema, as he will send the final revised method to W. M. Van Horn.

#### *Proposed Standard Methods*

E. O. Dillingham last year submitted his research work to the committee in the form of a report entitled "A Manometric Method for the Rapid, Practical Determination of Biochemical Oxygen Demand." W. M. Van Horn stated that this report is being prepared as a tentative standard and further advised that the tentative method as submitted to the committee will be simplified in scope and equipment. It was the opinion of the committee that this proposed method would be preferable to adopting the 5-day B.O.D. method as outlined in "Standard Methods of Water Analysis," as a TAPPI Standard Method.

#### *Report on the Joint Committee on the Uniformity of Methods of Water Examination*

R. S. Williams reported that the committee's activities for the past year have not been involved in problems of a biological nature. After some discussion it was decided that R. S. Williams should continue to act as the representative for the Microbiological Committee. It was further decided that R. S. Williams would review with the Microbiological Committee members any item which he either personally did not feel sufficiently competent to make a decision on, or which he felt required additional consideration by the committee members.

#### *New Members*

The names of several people were presented as possible new members for the Microbiological Committee. Tbese people will be contacted by W. M. Van Horn to determine whether or not they are interested in becoming members of the Microbiological Committee.

*Microbiological Committee*

#### *Acknowledgments*

The committee wishes to extend a vote of thanks to G. R. Hunt for the preparation of the microbiological program for 1959.

The motion for adjournment was raised, seconded and passed at 3:30 p.m.

R. F. Drescher, *Secretary*

## *Fourdrinier Committee*

A meeting of the TAPPI Fourdrinier Committee was held in Room 1048 of the Commodore Hotel on Monday, Feb. 23, 1959, during the TAPPI Annual Meeting. Chairman Ross Masterman called the meeting to order at 2:00 p.m. The following people were in attendance:

| | |
|---|---|
| R. C. Masterman | R. N. King |
| W. H. Kennedy | L. A. Lawrence |
| R. W. Peters | A. E. Levensailor |
| R. W. Hisey | R. C. Mack |
| S. A. Elliot | M. J. Maynard, Jr. |
| J. Hannegan | H. H. Morton |
| P. H. Hershey | R. C. Porter |
| E. J. Justus | J. Schad |
| J. A. Kelly | H. S. Spencer |

C. W. Walker

The minutes of the previous meeting, held at TAPPI headquarters on Sept. 19, 1958, were read and approved.

Mr. Matersman announced the untimely death of committee member R. J. Becker and stated that Mr. Kennedy had sent a note of sympathy to the Riegel Paper Co.

For the benefit of the new men in attendance, Mr. Masterman reviewed the plan of progression of officers of the committee. It was moved by Mr. Porter that this progression of officers be continued. This was seconded by Mr. King and carried. Mr. Masterman stated that the new officers then would be:

*Chairman,* W. H. Kennedy
*Vice-Chairman,* R. W. Peters
*Secretary,* R. W. Hisey

Mr. Kennedy announced that Mr. Masterman would remain in contact with our group since he has been appointed chairman of the Papermaking Division of which we are a committee. He then reviewed the activities of the committee, mentioning the questionnaires developed and reported on in the past and the papers to be presented at this year's Fourdrinier Committee session.

The last uncompleted questionnaire, Project No. 635, "The Problems of High Speed Machine Operation" was referred to Mr. Levensailor for review. He will report at the spring

*Fourdrinier Committee*

meeting on the possibility of preparing a report from this information.

Mr. Hershey was present to inform the committee more fully as to what he had in mind for his suggested project, "Fine Paper Quality Control." Mr. Hershey was concerned with the organization of the control function, the responsibilities, and functions of the manufacturing, technical service, quality control, and inspection departments. He also was interested in how to change the normal mill testing and control from a purely historical job into true process control. This second subject tied in very closely with a discussion by Messrs. Mullins and Becker at the last meeting. After a lively discussion it was the concensus that the problems brought out by Mr. Hershey were of extreme importance to all of us, but considerably broader in scope than our usual range. It was agreed that Mr. Hershey should write his notes up and present them to Mr. Masterman for consideration by the Manufacturing Division. Mr. Peters emphasized that we should consider what we could do in the process control portion of the problem.

*Project No. 734, Dandy Roll Practices.* Mr. Masterman reported that The Sinclair Co. would be delighted to assist in the preparation of any work on this subject. Mr. Hannegan was appointed chairman of the dandy roll subcommittee to be assisted by Mr. Schad and Mr. Kennedy in the execution of the projects.

*Project No. 735, Shake.* The progress of this project was interrupted by the tragic death of Mr. Becker. Mr. Spencer will report at the spring meeting on the status of further work on this project, particularly along the lines of a questionnarie.

*Project No. 736, Soft Lumps.* Mr. Hisey reported that progress was being made and more information on this subject being developed. The project was tabled for a year.

*Project No. 737, Rope Carrier Practices.* Mr. Elliot reported that Mr. Mullins has been actively progressing this work and will be able to be present and report at the spring meeting.

Chairman Kennedy then asked for any suggestions for work by the committee, in response Mr. Maynard suggested extension of the Canadian work on wire life and Mr. Porter suggested the general area of headbox design.

The spring meeting will be held at TAPPI Headquarters at 10 a.m., Friday, April 24.

The meeting was adjourned at 4:10 p.m.

ROBERT W. HISEY, *Secretary*

## *Coating Committee*

A meeting of the Coating Committee was held Feb. 23, 1959, at Hotel Commodore, New York, N. Y. Seated at the head table were Council Members Bonnanno, Loomer, Kaulakis, Wilber, Hagemeyer, and Landes.

*Attendance:* Total number of persons present: 79. Number of Coating Committee members present: 51. Present Coating Committee membership totals: 73.

The meeting was opened at 2 p.m., *A. D. Bonnanno presiding.*

### *Minutes of Previous Coating Committee Meeting*

With regard to minutes of meetings at Bedford, Pa., on May 15, 1958, it was noted that these minutes had previously been mailed to all members of the committee. It was moved and seconded that the minutes as submitted by mail be approved as written. Passed unanimously.

### *Yearly Report*

A report covering activities of the Coating Committee for the year February, 1958, to February, 1959, was submitted and read by Committee Chairman Bonanno. This report will appear in the April issue of *Tappi.*

### *Divisional Chairman's Report*

H. O. Ware, chairman of the Coating and Graphic Arts Division, took the floor and thanked Mr. Bonanno for his efforts in behalf of the Coating Committee over the past several years. He also called to the attention of all present that TAPPI had earlier that day awarded to Mr. Bonanno a certificate commending him for his services during the past year as chairman of the Coating Committee.

Mr. Ware also announced that Ward Harrison, president of TAPPI, had appointed R. T. Trelfa as chairman of the Coating and Graphic Arts Division, and J. T. Loomer as chairman of the Coating Committee, for the coming year.

### *Appointment of Coating Council, Mr. Loomer Presiding*

Mr. Loomer appointed the following to serve on the Coating Council for the year 1959-60: J. E. Wilber (*vice-chirman*), C. G. Landes (*secretary*), F. Kaulakis (*senior member*), and R. W. Hagemeyer (*junior member*).

### *Research Projects (Mr. Bonanno)*

Mr. Bonanno reported on Research Project No. 111, Study of the Flow Properties of Coating Mixes (at University of Maine). It was stated that $24,000 has been appropriated to date. Although not many tangible benefits have been obtained, many intangible benefits have been obtained. Recently a Steering Committee of Messrs. Hemstock, Robinson, and Mattson was appointed to oversee this project. Mr. Bonanno recommended that the project be continued.

Mr. Henstock, chairman of the Steering Committee, reported on his committee's investigation of the project, in cooperation with the University of Maine. The committee found that the University of Maine was well equipped to carry out the project. It was concluded that the objectives of the project were too broad, and poorly defined. Nothing of a fundamental nature has been found to date.

Mr. Hemstock believes that with a narrower objective and suitable guidance from the Steering Committee a good research program can be carried out. The objective will be to determine the relationship between the rheological properties of coating color and such phenomena as color penentration, film splitting and film patterning, etc.

It is hoped to keep the work fundamental in nature, with sufficient flexibility to pursue new leads.

### *Discussion*

Miss Cobb referred to the work of Lehigh University in film splitting, etc. Mr. Hemstock stated that a review of the Lehigh work in this field would be in order. It was mentioned from the floor that the paint industry has done a lot of work in the field of rheology. Mr. Kessler asked about the possibility of sponsoring work at both Lehigh and the University of

*Coating Committee*

Maine. Mr. Hemstock commented that the appropriation request in question ($6500) might be diluted too much if divided.

Mill Cobb suggested the possibility of hiring a consultant to help guide the project. It was pointed out that the recently appointed steering committee includes three highly competent coating rheologists, who are now acting as consultants for the project.

Mr. Jenness (University of Maine) pointed out that specific results and data from the work at the University of Maine have not yet been reported, but will be covered in a paper to be given at the Boston conference in May, 1959.

Mr. Willets moved that the Coating Committee request an appropriation of $6500 from TAPPI to continue the project for another year. Seconded by Mr. Hall. Passed unanimously.

***Reports on Monographs (Mr. Wilber)***

*Project No. 302.* Rawstock. George McKnight reported that progress had been slow and disappointing. Replies to a questionnaire had been vague and insufficient in number. After considerable discussion from the floor, it was moved by Mr. Martinek and seconded by Mr. Georgevits that Project No. 302 be dropped. Passed unanimously.

It was then suggested by Mr. Schmutz that perhaps a chapter on coating rawstocks could be included in some other monograph. Mr. Georgevits suggested that such a chapter might fit in well with a monograph on application methods.

*Project No. 569.* Revision of No. 9 on Protein and Synthetic Adhesives. Messrs. Silvernail and Bain reported that all chapters of the revised monograph will be completed before the May meeting in Boston.

*Project No. 303.* Defoamers and Waxes. It was stated that this monograph will now be entitled "Coating Additives." Mr. Sowerbutts reported that he now has four members on his subcommittee. It has been difficult to get authors because of secrecy restrictions imposed by many of the companies.

Mr. Wilber pointed out the importance of coating additives and suggested that it might be combined with some other monograph, perhaps on a narrower scope. Messrs. Loomer and Wilber requested volunteers to serve on the subcommittee and suggested that this committee should report at the next Coating Committee meeting with a specific list of subjects and products to be included in the monograph. Mr. Hall and a representative of Dow Chemical Co. volunteered to serve on the additives subcommittee, and additional volunteers are welcome.

Pigments Monographs. The revised monograph has been published. Miss Cobb congratulated the authors, and stated that the revision represented a definite improvement.

A. M. Brooks stated that Chapter III had been published in spite of certain objections that he had raised, and asked for an opportunity to publish corrections. Mr. Loomer asked Mr. Brooks to write him listing the corrections desired.

Monographs No. 8 and No. 11. Messrs. Loomer and Wilber stated that Monograph No. 8 (Machinery for Paper Coating) and Monograph No. 11 (Preparation of Paper Coating Colors) were out of date because of recent revolutionary advances. Also, No. 8 is out of print. It has been suggested that the two monographs be combined and a revision prepared.

After some discussion Mr. Loomer appointed G. L. Booth as chairman of a subcommittee to prepare a revised monograph on the preparation and application of "Machinery and Methods for Paper Coating Colors" (exact title not designated).

N. Millman was appointed as vice-chairman, with the responsibilities for the section on preparation of coating colors.

It was suggested that steps be taken to get mill men on the committee as soon as possible.

Mr. Willets suggested that in the future galley proofs on all monographs be submitted to all members of the subcommittee working on the monograph in question. Mr. Loomer stated that this procedure would be followed.

***Reports on Projects (Mr. Loomer)***

*Project No. 598.* Survey of Drying Methods. Report dated Feb. 20, 1959, was made by L. W. Egan and copies distributed to all present. Mr. Egan was appointed for Mr. Loomer to carry out a survey of corrective drying and to write a paper on the subject.

*Project No. 599.* Survey of Factors Affecting Coating Weight. Mr. Loomer asked for volunteers to make the survey. There were no volunteers and Mr. Loomer delayed action on this project.

*Project No. 600.* Particle Packing. Mr. Hagemeyer reported that the subcommittee had made a detailed report (Progress Report No. 1) at the Bedford meeting in 1958, and then had sent copies of the progress report to all members of the Coating Committee, together with a questionnaire requesting opinion on the work and the desirability of continuing the project. He reportee that opinion was nearly unanimous in favor of continuing the project. In the discussion that followed, Miss Cobb stated that she was not clear as to the exact objective of the work.

Because of becoming a member of the Coating Council, Mr. Hagemeyer resigned as chairman of the subcommittee in charge of Project No. 600, and Mr. Loomer appointed J. V. Robinson to take his place.

***Mid-Year Meetings of Coating Committee***

Mr. Landes reported on results of a questionnaire (sent out Nov. 17, 1958), to determine the sentiment of the Coating Committee on holding a fall meeting of the committee as against a longer meeting at the annual May conference. The committee was about evenly divided with regard to the desirability of holding an interim fall meeting, but was 2 to 1 in favor of holding a half-day committee meeting at the May conference.

After a show of hands on several possibilities for 1959, Mr. Loomer stated that a meting of the Coating Committee would be held Monday morning, May 25, in Boston. There will be no other conference meeting at this time.

***Report on 1959 Coating Conference (Mr. Kaulakis)***

Mr. Kaulakis announced that plans were nearly completed. The principal conference committee chairmen are: Marchetti (Treasurer), Kilty (Local Arrangements), and Hagemeyer (Program). Trips will be taken Tuesday afternoon (May 26) to Oxford (Lawrence), Nashua Corp., and Dewey and Almy. The theme will be a panel on "Coatings—Past, Present, and

Future," with four outstanding speakers. The luncheon speaker will be Stanton Mead, president of Consolidated Water Power and Paper Co.

***Report on 1960 Coating Conference (Mr. Hagemeyer)***

Mr. Hagemeyer announced the following Conference Committee appointments: Martinek (Program), Welliver (Publicity), and Cairns (Local Arrangements).

The possibility of holding a joint conference with the Graphic Arts Committee is being investigated. Suggestions on a theme for the conference are welcomed. Those received to date include:

Printability
Functional coating
Coating as related to graphic arts
Economic aspects of coating
Coating of bleached board
Starch in paper coating

***Future Conferences (Mr. Loomer)***

Mr. Loomer announced the dates of future conferences as follows:

1960—May 23 to 25, Edgewater Beach Hotel, Chicago
1961—May 15 to 17, Hotel Statler, Buffalo
1962—May 14 to 16, Hotel Netherland-Plaza, Cincinnati
1963—There are two possibilities to date, French Lick, Ind., and Atlantic City.

In discussing possible locations, it was emphasized that we must make hotel reservations several years ahead, and that the size of the conference limits the location to those few hotels that can handle the group satisfactorily. On suggestion was that the 1963 meeting should be held in the southern part of the country because of the rapid increase in coating at southern mills.

After further discussion Mr. Rice moved that French Lick be approved as a site for the 1963 conference, Mr. Kaulakis seconded. Passed unanimously. Mr. Loomer mentioned that a southern location can be considered for later.

***New Projects (Mr. Frankevicz)***

Mr. Frankevicz reported that a committee is being formed to recommend new projects. He called attention to two possibilities:

(a) Further development of the pigment volume concept, as suggested by Willets and Marchetti.

(b) Study of the theory of the trailing blade application method and investigation of the rheology of coatings used for the trailing blade versus film splitting methods.

An attempt will be made to secure additional committee members for study over the next few months. Work on new projects will come under the administrative jurisdiction of Mr. Wilber.

***Data Sheets (Mr. Landes)***

Mr. Landes reviewed previous efforts to initiate the development of data sheets pertaining to paper coating. There is a need for coating data sheets and it was recommended that a subcommittee be formed to start work on this task. There were no volunteers and Mr. Loomer tabled the matter pending appointment of a chairman to investigate the matter.

***Coating Committee Membership (Mr. Wilber)***

Mr. Wilber reviewed current membership requirements and also referred to recent action of the Council in this regard. Before any members are dropped for nonattendance they will be notified so that they have an opportunity to remain on the committee if they so desire.

Members not shown on the membership list of Feb. 19, 1959 (distributed at the meeting) were requested to notify the secretary (Landes) so that the list can be corrected. Applications for membership may be obtained from TAPPI headquarters or the secretary.

***Liaison Reports***

*TAPPI Joint Advisory Committee on Printability.* Doyle Boggess's report was read by Mr. Bonanno. Mr. Boggess stated that there had been no meetings of the Advisory Committee and, therefore, no need for activity on his part. Mr. Loomer requested the secretary to investigate the current status of the advisory subcommittee and determine whether or not further liaison is indicated.

*ASTM Committee D-25, Testing and Analysis of Casein."* John L. Rice reported that the committee has accomplished a lot. He plans to prepare a list of the current proposed tests, and this list will be circulated by the secretary to members of the Coating Committee.

*Routine Test Methods.* J. R. Gunning reported that this committee meets regularly. Several new routine test methods will be published in an early issue of *Tappi.* Mr. Gunning urged all Coating Committee members to be on the look out for routine test procedures related to paper coating and coated paper.

***New Business***

None.

***Remarks by Divisional Chairman (R. T. Trelfa)***

Mr. Trelfa reviewed the history of the Coating Committee and its objectives. He emphasized the necessity of active participation by all members of the committee, and suggested the possibility of forming additional subcommittees each to be interested in a specific area of coating technology. All committee members were urged to make suggestions to the chairman for improving the work of the committee.

It was moved, seconded, and passed that the meeting be adjourned. Adjourned at 4:45 p.m.

C. G. Landes, *Secretary*

## *Corrugated Containers Process and Quality Control Committee*

A meeting of the Process and Quality Committee Control was held at the Hotel Commodore, New York, at 9:30 a.m., Feb. 24, 1959, with the following attendance:

H. Seibel, Gaylord Container Corp.
H. Dunholter, Eastern Box Co.
D. M. Long, River Raisin Paper Co.
H. G. Nelson, Owens-Illinois Glass Co.
F. Albert, Menasha Wooden Ware Corp.
S. L. Goodrich, General Box Co.
H. I. Stallsmith, Green Bay Box Co.
N. Varner, Union Bag–Camp Paper Corp.
A. Schwartz, David Webber Co.
H. J. Ostrowski, Hinde & Dauch Paper Co.
L. Timmer, Ft. Wayne Corrugated Paper Co.
G. C. Lecky, F. J. Kress
K. Lord, Brown Instruments Div., Minneapolis-Honeywell
C. J. Zusi, Consultant
A. W. Hoffman, Continental Can Co.
R. R. Chase, Union Bag–Camp Paper Corp.

***Minutes of Previous Meeting***

The minutes of the previous meeting were approved as written.

***Election of Officers***

The following were voted into office, following the recommendations of the nominating committee:

*Chairman*, K. R. Martin
*Vice-Chairman*, H. Seibel
*Secretary*, H. Dunholter

These men take office immediately, and will remain in office until Jan. 1, 1960.

***Steering Council Report***

It was reported that the Steering Council has declared that

*Corrugated Containers Process and Quality Control Committee*

the election of committee officers shall henceforth take place at the fall conference, and those elected shall take office on Jan. 1, following.

***Annual Meeting—1959***

H. G. Nelson, general chairman, reported on the arrangements for the three technical sessions sponsored by the Process and Quality Control Committee.

***Projects***

*No. 752.* H. Stallsmith reported that several portions of the questionnaire were not phrased so as to elicit the desired information. G. Lecky, N. Varner, and S. Goodrich were appointed to work with H. Stallsmith on improving the questionnaire. It will then be presented to the entire Process and Quality Control Committee at the fall meeting.

*No. 753.* The information compiled on laboratory equipment has been prepared for distribution at Technical Session I. K. R. Martin will announce the availability of the information and solicit comment.

H. Seibel will serve on the panel at Technical Session III to answer any questions on the list.

*No. 754.* Work on this project has been held up until after the Annual Meeting. L. Timmer, G. Lecky and possibly G. Moltenfort will assist the project chairman, H. G. Nelson.

*No. 761.* F. Albert, project chairman, reported on the results of the questionnaire submitted to the committee members. L. Timmer and H. Ostrowski will assist in planning further work. Container Laboratories may be asked to participate in this.

*No. 762.* H. Dunholter, project chairman, has been unable to give much time to this long term project because of demands of the Annual Meeting. Initial work will be limited to the corrugator, presses, tapers, and stitchers. A listing of equipment and possible defects will be prepared before worrying about the correction. Anyone having information that might be used for this should submit it to H. Dunholter.

A. Schwartz, H. Seibel, and N. Varner will assist H. Dunholter with this project.

***1960 Fall Conference***

The Process and Quality Control Committee will be responsible for one session at this conference.

H. Ostrowski was suggested as a moderator.

A possible theme for the session would be "Packaging."

Each committee member is to submit a list of subjects for this meeting to K. Martin.

***Nominating Committee***

The following nominating committee was appointed: N. Varner, *chairman*, and L. Timmer and A. Schwartz.

The meeting was adjourned at 11:30 a.m.

W. P. Blamire
for H. Dunholter

## *Container Testing Committee*

A meeting of the Container Testing Committee was held Feb. 24, 1959, at the Hotel Commodore, New York, N. Y.

The meeting was called to order by the chairman, M. J. Clark, at 10:30 a.m.

The following members were present:

M. J. Clark, *chairman*, Inland Container Corp.
A. W. Hoffman, *vice-chairman*, Continental Can Co.
G. C. Lecky, *secretary*, F. J. Kress Box Co.
W. J. Balster, The Don L. Quinn Co.
T. J. Gros, Union Bag–Camp Paper Corp.
A. V. Grundy, Quartermaster Food & Container Institute
B. Q. Haynes, B. F. Perkins & Son, Inc.
J. J. Kipnees, Container Laboratories
E. A. Knapp, W. Va. Pulp & Paper Co.—H & D Div.
C. S. Macnair, Acme Steel Co.
G. W. Menkes, Testing Machines, Inc.
T. J. Muldoon, Fibre Box Association
W. S. McDonald, International Paper Co.
H. G. Nelson, Owens-Illinois Glass Co.
H. J. Ostrowski, Hinde & Dauch Co.—Canada
C. H. Root, Continental Can Co.
R. E. Swingle, Acme Steel Co.
C. J. Zusi, Consultant

Visitors present were, C. E. Brandon, Miami University, and C. M. Swalm, Campbell Soup Co.

Two new members, T. J. Gross and C. H. Root, were welcomed to the committee by the chairman.

***Subcommittee Reports***

*Flat Crush.* The subcommittee chairman, Mr. Nelson, reported that the Container Laboratories had completed the work on the flat crush project and had submitted the final bill for payment. They had sent the analysis of variance data to him and he pased out to the members a résumé of that data.

A discussion followed on the differences that are indicated between results obtained on the H & D and the National Forge machine, and how these differences could be handled in writing up the method. It was brought out that The Institute of Paper Chemistry had published a "Study of the Speed of Loading and Response on the H & D and National Forge Machines." Mr. Nelson was to write Bob McKee and try to get a copy of this study. Mr. Nelson was also to summarize the analysis of variation data to include the machine variation and per cent of difference of the different items, have this duplicated and sent out to the committee members in time for the fall meeting.

The secretary was instructed to write to the Container Laboratories and thank them for the fine job they had done on their study of the effect of the sample size and shape, machine speed and machine design on the flat crush test. The chairman also complimented Mr. Nelson on the fine job he had done in bringing the job to its present state of completion.

*Mullen Test.* The Mullen Test Subcommittee chairman, Mr. Grundy, stated that a task force had been formed, consisting of Messrs. Balster, Swingle, Knapp, and Zusi, to draw up a proposed method of test for bursting strength of container board. This task force met on January 27 in Chicago to review and discuss this proposal, using as a basis a method published by The Institute of Paper Chemistry in 1948 in the *Fibre Containers* magazine. The task force's recommended new proposal was submitted to the committee, and after some discussion, it was decided to send this procedure out to the committee members for a letter ballot as a "Proposed Method of Test for Bursting Strength of Container Board."

*Container Testing Committee*

Mr. Ostrowski stated that he had been asked by Mr. DeLong, chairman of the Mullen Subcommittee of the Paperboard Committee, to report back to that committee our plans on a Mullen test procedure. It was thought that by simply changing the scope of the proposed method, it might also be applicable to paperboard and come under the jurisdiction of both committees.

Mr. Clark explained that there was also work being done by the Paper Testing Committee on Mullen testing but that their work was with a different type of Mullen tester and with lighter weight papers.

*Compression Test.* The chairman of the Compression Test Subcommittee was not present, so Mr. Clark stated that the results of the letter vote on the last recirculation of the compression test procedure had been:

13—affirmative
7—negative
1—not voting

The main objection to the procedure seemed to be its reproducibility paragraph, and it was suggested that this paragraph be cut out of the procedure. It was decided to find out from the subcommittee chairman just what the status of the procedure was at the present time.

It was brought out that in order to have a tentative standard approved, we would need a 75% affirmative vote of the committee members, and that the total number of answers both for and against on this ballot did not total 75%. It was then suggested that the secretary ask TAPPI Headquarters to circularize the present committee to find out how many of those listed on the committee were still actively interested in remaining on it.

Mr. Brandon, chairman of the Testing Division, spoke and explained that the procedure for sendings out ballots within the division was being streamlined in order to make it simpler to get methods approved.

The committee chairman stated he had requested that the scope of our committee be changed to read as follows:

"The development and revision of testing methods, specificially for shipping containers; i.e., corrugated and solid fiber, container board, packages, and pallets. Also nomenclature and definition of terms relating to same."

Time ran out on the meeting before the chairman could bring before the committee for discussion the subject of the status and action to be taken on our already authorized committee projects and methods that need review, that is, all methods over ten years old.

The next meeting will be in conjunction with the corrugated containers session at the Jung Hotel in New Orleans, Sept. 15–17, 1959.

Meeting adjourned at 12:30 p.m.

G. C. Lecky, *Secretary*

## *Chemical Methods Committees*

Meetings of the Chemical Methods Committee were held at the Hotel Commodore, New York, N. Y., Feb. 23 and 24, 1959.

The following persons were in attendance:

Earl S. McColley, *Chairman,* Celanese Corp. of America, Cumberland, Md.
William K. Wilson, *Secretary,* National Bureau of Standards, Washington, D. C.
L. Aldrich, W. Va. Pulp and Paper Co., Covington, W. Va.
John Reyne, Key Chemicals Corp., Miami Springs, Fla.
C. P. Kool, W. Va. Pulp and Paper Co., Covington, Va.
Albert R. Reid, Hercules Powder Co., Wilmington, Del.
Sterling Bailey, N. Carolina Pulp Co., Plymouth, N. C.
B. W. Forshee, National Bureau of Standards, Washington, D. C.
L. T. Eby, Enjay Co., Inc., Elizabeth, N. J.

Several methods were discussed by the group, and a summary of these discussions is given below. We should be glad to have comments on any of these methods, methods that need revision, or suggestions for new methods.

### *T 19, Pentosans in Wood*

Last February, it was voted to revise T 19, Pentosans in Wood, to agree with T 223, Pentosans in Pulp. This was done and the method was distributed in May, 1958. There were five votes in favor of and no votes against the method. There were, however, a number of comments. It was suggested that the section on sodium thiosulphate solution, 0.1 *N*, be revised as follows: "25.3 g. $Na_2S_2O_3 \cdot 5H_2O$, dissolved in water containing 1 g. of $Na_2CO_3$ and diluted to 1 l. After one week, standardize the solution against potassium dichromate, potassium iodate, or pure copper." Under "d. Potassium Bromate—Bromide Solution," the sentence "Add 1 ml. of NaON—"should be changed to "Add one gram of $Na_2CO_3$ and dilute to 1 l." Under *Procedure,* correct "fibers" in the second line of the second paragraph to "wood."

In the calculation as sent out was a factor of 7.58 and a negative correction of 1.1. It was pointed out that a factor of 7.50 and a correction of 0.60 would be much better for wood.

After a few more editorial corrections, the procedure will be essentially the same as the proposed T 223 for pentosans in pulp. When we discussed this a year ago, we thought that the bromination procedure was pretty well established for values above 10% pentosan and that either the aniline acetate or the orcinol procedures could be used for the lower ranges. A revised Tentative Standard T 223 m-58 was issued in April, 1958, so that we do have a published method that can be used.

It was pointed out that Mr. Bethge is recommending a bromination at room temperature and it was therefore decided, by vote, to hold this method pending further investigation of the room temperature bromination.

### *T 223, Pentosans in Pulp*

An interlaboratory round robin has been conducted using the orcinol method, the aniline acetate method, and the TAPPI bromination method at ice temperature. The orcinol method gave excellent results over the whole range; the TAPPI method gave results which compare favorably with the orcinol method over the range tested which was from 4 to 16% pentosans. The data show that five analyses by the aniline acetate method would be required to obtain the same precision as one determination by the orcinol method. The tentative method for Pentosans in Pulp T 223. has already been printed, but it is recommended that the orcinol method be substituted for the aniline acetate method and that certain revisions be made in the bromination method. When the revised method has been written it will be submitted for consideration of the committee. It was voted that the method be held for these revisions.

*Chemical Methods Committee*

***T 428, Water Soluble Acidity or Alkalinity of Paper***

The method under discussion calls for boiling the paper under reflux, filtering off the paper, and titrating the filtrate. It was pointed out that the boiling may cause some of the components of the paper to hydrolyze and thus give a completely fallacious concept of the actual materials present. Some loss of volatile acids may occur during the boil. It was suggested that the method be revised as follows: the paper shall be macerated with water at room temperature in a Waring Blendor and filtered; the filtrate shall be titrated to a pH of 7.5 with a pH meter. Sterling Bailey of the North Carolina Pulp Co. will take this method and prepare a revision for our consideration.

***T 406, Reducible Sulphur***

After some discussion it was voted that the tentative method submitted to the committee be accepted after inclusion of the diagram of the apparatus, which is to be furnished by Mr. Browning of The Institute of Paper Chemistry.

***Nitrogen in Paper***

This paper was briefly discussed and given to Mr. Forshee. After critical examination Monday evening, he reported to the committee and the procedure was accepted. Directions for the Hengar method were referred to the Routine Control Methods Committee.

***T 202, Chlorine Consumption***

This method, prepared by Lyman Aldrich, was discussed and tentatatively approved at the Savannah meeting. It is a modification of the old chlorine number method and is based on work at the Pulp and Paper Institute of Canada. The apparatus is available from the Scientific Glass Co. This method is recommended as a replacement for the present chlorine number procedure. It has been approved by letter ballot last fall, but after some discussion was approved with a change under *Reagents* from "dilute with 5% water" to "add 5% by volume of water." A few other editorial changes were suggested.

***T 419, Starch in Paper***

A colorimetric procedure for starch in paper, based on the method of Browning, Bublitz, and Baker, was circulated last September. This is being revised on the basis of comments that were received, and it is expected that the revised method will be ready for letter ballot in a few weeks.

***T 214, Kappa Number of Pulp***

This method has been approved. As it is the first standard method approved by the International Committee for Cellulose Analysis and is written in English, TAPPI should hold to the wording of the international method as closely as possible. Mr. Aldrich will insert a few editorial changes but no changes in the actual method will be made.

***T 203, Alpha-, Beta-, and Gamma-Cellulose in pulp***

Although this method has been published in *Tappi* and has also been published in loose-leaf form, there are still some errors. Some of these corrections have been published in *Tappi*. A revision, including the suggested corrections, was carefully examined and accepted. In the course of the discussion it was stated that the disintegration of the pulp in a stainless steel beaker by means of a flattened steel stirring rod will reduce alpha values by as much as 2.5% in some cases.

***T 235, Solubility in Cold Sodium Hydroxide***

This method also has been published in *Tappi* and printed as a tentative method. Several corrections of an editorial nature were and accepted.

***T 211, Ash in Pulp; T 15, Ash in Wood; and T 14, Ash in Paper***

All of these methods have been published in *Tappi*. All present were in agreement with the methods as printed.

***Mercury in Paper***

A procedure for mercury in paper was presented at the TAPPI meeting last February by L. G. Borchard and B. L. Browning. This has been written up as a proposed TAPPI method and has been distributed. We have received favorable comments on it, all more or less tentative, but we are not yet ready to recommend a method.

***T 632, Analysis of Sodium Silicate***

We have received copies of a proposed revision of T 632 on the analysis of sodium silicate for our examination in cooperation with the Papermaking Chemicals Committee. Albert R. Reid has been appointed to confer with Mr. Morse on this method.

***Copper in Paper***

A method for copper has been accepted by letter ballot after inclusion of some editorial changes. The method was accepted by the committee.

***Manganese in Paper***

A method for manganese has been distributed and approved. After some editorial changes, the method was accepted by the committee.

***T 3, Moisture in Wood Chips and Sawdust by Toluene Distillation***

This method was published in the September issue of *Tappi*. No corrections were offered. The method as published is considered to be satisfactory.

A method for Qualitative Analysis of Mineral Filler and Mineral Coating of Paper was sent out from TAPPI headquarters. After a brief discussion, this method was approved with the stipulation that it would not be forwarded until it had been critically examined by C. P. Kool. Mr. Kool has been appointed to serve with the Joint ASTM-TAPPI task group formed to develop a *quantitative* method for the determination of mineral fillers in paper coatings.

***Carboxyl Groups in Cellulose***

Carboxyl determinations on the ICCA reference pulps have been made in several laboratories by the Davidson, Ant-Wuorinen, Karin Wilson, Doering, Sobue and Dkubo, and Plunguian methods.

Although the values for any one pulp cover a fair range, it is surprising that the data agree so well. The next step is to

test two or three methods in several laboratories and select one, or possibly two methods as ICCA standards.

***Moisture in Cellulose***

John Cousins of the Pulp Testing Committee will write up a method, based on the ACS-ASTM procedure. Mr. Aldrich will review this write-up before it is submitted to the committee.

***Miscellaneous***

Two inquiries to TAPPI headquarters concerning different methods were referred to the Chemical Methods Committee. One was for information on a method for the determination of phenolic resins in paper and the other requested information on a method for the determination of the combination of waxes, resins, and sizing in paper. Anyone who has information on these items should contact Mr. McColley or Mr. Wilson.

***Publications***

Arthur D. Little, Inc., would like to publish technical reports that they have in their files, and have requested information on what might be of interest. Suggestions should be sent directly to F. G. Perry, Jr., of Arthur D. Little.

***Tenth Testing Conference***

The Tenth Testing Conference will be held in Portland, Ore., Aug. 17–21, 1959. The general theme of the conference will be "Pulp Testing," but other phases of testing will be discussed. One session will be devoted to precision. If anyone has a paper suitable for presentation at this meeting, please get in touch with the Program Chairman, S. M. Chapman, Pulp and Paper Research Institute of Canada, 3420 University St., Montreal, Canada.

Membership of the Chemical Method Committee is currently as follows:

Earl S. McColley, *chairman*, Celanese Corp. of America, Cumberland, Md.
J. W. Jacokes, *vice-chairman*, American Enka Corp., Enka, N. C.
William K. Wilson, *secretary*, National Bureau of Standards, Washington 25, D. C.
Sterling Bailey, Technical Director, North Carolina Pulp Co., Plymouth, N. C.
H. C. Brill, Pigments Technical Service Lab., E. I. du Pont de Nemous and Co., Wilmington 98, Del.
B. L. Browning, The Institute of Paper Chemistry, Appleton, Wis.
C. P. Donofrio, Pulp and Paper Department, New York State College of Forestry, Syracuse, N. Y.
Donald F. Durso, Buckeye Cellulose Corp., Memphis, Tenn.
L. T. Eby, Enjay Co., 1141 E. Jersey St., Elizabeth, N. J.
B. W. Forshee, National Bureau of Standards, Washington 25, D. C.
John F. Gorham, University of Maine, Orono, Me.
Raymond S. Hatch, Hudson Pulp and Paper Co., 477 Madison Ave., New York 22, N. Y.
Arthur F. Johnson, Buckeye Cellulose Corp., Memphis, Tenn.
N. H. Keeney 79 Bartlett St., Chelmsford, Mass.
C. P. Kool, Chief Chemist, West Virginia Pulp and Paper Co., Covington, Va.
Paul L. Leemhuis, Hammermill Paper Co., Erie, Pa.
Charles H. Lindsley, American Enka Corp., Enka, N. C.
Robert H. MacClaren, Eastman Kodak Co., Kodak Park Works, Rochester 4, N. Y.
A. S. O'Brien, Eastman Kodak Co., Kodak Park Works, Rochester 4, N. Y.
R. H. Ramsay, 212 Park St., Berlin, N. H.
Albert R. Reid, 12 B Thomas Dr., Monroe Park, Wilmington 6, Del.
John Reyne, General Manager, Key Chemicals Corp., P. O. Box 692, Miami Springs, Fla.
Jerome F. Saeman, Forest Products Laboratory, Madison 5, Wis.
E. P. Samsel, Dow Chemical Co., Midland, Mich.
Forrest Sutphin, W. Va. Pulp and Paper Co., Covington, Va.
J. E. Tasman, 81 Fifth Ave., Pointe Claire, P. Q., Canada

WILLIAM K. WILSON, *Secretary*

## *Paper Shipping Sack Testing*

The following were in attendance at the TAPPI Paper Shipping Sack Testing Committee Meeting held at Hotel Commodore, New York, 10:00 a.m., Wednesday, Feb. 25, 1959:

K. A. Arnold, *chairman*, technical director, St. Regis Paper Co.
R. P. Anderson, multiwall research director, St. Regis Paper Co.
A. R. Ewing, technical director, Bemis Bro. Bag Co.
R. P. Kessler, manager, Multiwall Packaging Laboratory, West Virginia Pulp & Paper Co.
H. C. Martin, technical superintendent, Olin Mathieson Chemical Corp., Forest Products Division
C. P. Spring, quality control director, Mill Division, Owens-Illinois
*H. S. Welsh, vice-president and technical director, Clupak, Inc.
F. Pocta, *secretary*, Paper Shipping Sack Manufacturers' Assn., Inc.

*Guests:*

B. S. Halsey, Albemarle Paper Manufacturing Co.
J. F. Turner, West Virginia Pulp & Paper Co.

***TAPPI Projects***

*No. 769.* The subcommittee appointed to develop new TAPPI Project No. 769 (1958)—A Suggested Method for Determining Tensile Engery Absorption of Paper—was as follows: Hewitt S. Welsh, *chairman*, K. A. Arnold, M. L. Taylor, D. M. Yost, and F. Pocta, *secretary*.

The subcommittee in charge of the development of Project No. 769 will present their recommendations for a proposed new TAPPI Suggested Method for determining tensile energy absorption of paper. Work has already progressed up to the stage where this new TAPPI Suggested Method has been written and carefully reviewed by members of the subcommittee, and only a few minor refinements may be necessary for TAPPI acceptability and approval. The opening paragraph of the proposed new TAPPI Suggested Method for determining tensile energy absorption of paper states that the suitability of paper for many end-uses depends upon its ability to absorb energy. This energy absorbing capacity of a paper can best be characterized by the area under its load-elongation curve. This area has the units of force times distance and when it refers to unit area of paper is referred to as tensile energy absorption.

*No. 607.* Development of a procedure for dry tensile testing of shipping sack papers (1955).

* H. S. Welsh was newly appointed a member of the TAPPI Paper Shipping Sack Testing Committee, as was John W. Gladstone, quality control supervisor of the Halifax Paper Co., Div. of Albemarle Paper Manufacturing Co.

***Paper Shipping Sack Testing Committee***

C. P. Spring, who is chairman of the subcommittee responsible for this project, reported that he had attended a meeting of the TAPPI Precision Committee to hear their analysis of dry tensile strength round robin test results, based on the consolidated report put out by the John I. Thompson Co. of Washington. He reported that basically they tell us that there is no significant difference in the readings from the three different types of tensile testers; that within each given type of instrument, however, there are some significant differences between laboratories, which do not follow any particular pattern.

Mr. Spring said that T. Lashof, who did most of the analyzing of the results, reported a significant difference between the 5 to 9 sec. time-to-break and the 17 to 25 sec. results; that the precision for the two speeds is similar, however, so he believes that the TAPPI paper testing group will adopt the fast test.

He advised that this means, in general, that the tensile testing of shipping sack kraft paper by most manufacturers and consumers will, so far as time to break the strips is concerned, fall within the limits of the expected revision of TAPPI Method T 404.

He thought that, provided the TAPPI Paper Testing Committee does approve the fast breaking speed, the committee's Project No. 607 could be considered as finished.

This will also require, he said, a slight modification in the test method called for in UU-S-48c, and that reference to the pulling speed of 12 i.p.m. would have to be eliminated, which would leave only T 404 as a reference.

He presented large sheets of data on TAPPI Project No. 607 as prepared by the John I. Thompson Co.

*No. 608.* Procedure for wet tensile testing of wet-strength shipping sack papers (1956). Chairman Arnold requested the subcommittee responsible for the development of Project No. 608 to be prepared to report progress at the next TAPPI Testing Conference.

***Measurement of Coefficient of Friction of Multiwall Sack Paper (1958)***

R. P. Anderson advised that at the Ninth TAPPI Testing Conference in Savannah, Ga., the chairman of the TAPPI Paper Shipping Sack Testing Committee had requested him to report on available equipment designed to measure the coefficient of friction of multiwall sack paper as an indication of frictional resistance of filled sacks in storage.

Chairman Arnold pointed out that this project is altogether separate from Project No. 605, which was published under the title of "Smoothness of Paper under 3 P.S.I. Clamping Pressure," the proposed new TAPPI Suggested Method T 490.

The following subcommittee was appointed to assist in the development of this project: R. P. Anderson, *chairman*, A. R. Ewing, R. P. Kessler, and H. C. Martin.

F. Pocta, *Secretary*

## *Microscopy Committee*

A meeting of the Microscopy Committee was held during the 44th Annual Meeting of TAPPI in the Hotel Commodore, New York starting at 9:00 a.m., Tuesday, Feb. 24, 1959. Chairman I. H. Isenberg presided. The following members were present:

I. H. Isenberg, Institute of Paper Chemistry
A. G. Lang, Champion Paper and Fibre Co.
D. V. Lent, Alton Boxboard Co.
A. P. Tracey was represented by L. Shakley, John A. Manning Paper Co.
R. H. Simmons, U. S. Bureau of Engraving and Printing
H. C. Koch, Weston Paper and Manufacturing Co.

C. E. Brandon and D. N. Obenshain visited the committee meeting and led a helpful discussion of the recent changes in the Testing Division operations.

*Microscopy Committee*

TAPPI method T 10 a-47, Species Identification of Nonwoody Vegetable Fibers, was discussed at condiderable length. It was felt that the method would not require complete revision, but preparation of a new series of fiber photomicrographs at a standard magnification was considered desirable. Tentative plans were laid to have these made through the cooperative efforts of several members of the committee so as not to burden any one laboratory more than necessary. D. V. Lent will be chairman of task force.

During the discussion of Project No. 577 concerned with developing a method for the identification of printing, it was suggested that this be presented to the graphic arts committee for their consideration and possible joint effort. R. H. Simmons has been assigned responsibility for this project.

The chairman will contact F. L. Simons regarding Project No. 469 which is the presentation of a microscope use monograph. Mr. Simons, who is in charge of this project was unable to attend the meeting.

A committee comprising H. C. Koch, I. H. Isenberg, and F. L. Simons, was appointed to nominate a slate of officers for the coming year.

The committee regularly holds a second meeting of the year at the fall Testing Conference. It appeared, however, that the number of the committee members attending the Portland, Ore., meeting could not be gaged at this time. A formal meeting there was, therefore not scheduled.

The meeting was adjourned at 11:45 a.m.

H. C. Koch, *Secretary*

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**Tenth**

**Testing Conference**

**of the**

**Technical Association**

**of the**

**Pulp and Paper Industry**

**Multnomah Hotel, Portland, Ore.**

**Aug. 17–21, 1959**

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# ENGINEERING DIVISION

## *Committee Contributions*

### *Questions and Answers*

DURING the last several years, substantial interest has been indicated in a monthly Question and Answer column in *Tappi*. To fulfill this interest, the Engineering Division established a permanent committee to develop answers to those submitted questions of an engineering nature. The vice-chairman of the Division is the permanent chairman of the Question and Answer Committee. A member of each of the committees within the division will act as liaison member of the Question and Answer Committee and will be responsible for the review of the material pertinent to the scope of his committee's activities.

Good engineering questions are solicited as well as answers or alternate answers to the published questions. Material should be sent to TAPPI Headquarters, marked for the attention of H. O. Teeple. The items contributed will be forwarded to the Question and Answer Committee for processing.

Listed below are a number of questions that have been submitted. Some answers are provided which were developed by the Question and Answer Committee. If comments are to be contributed, please refer to the question number.

(*1*) *Question:* How can we ensure a balanced flow of stock through a number of refiners or jordans operating in parallel, especially where these units are operated as pump-through units with no opportunity for headboxes on inlet or discharge? We must do the job economically.

(*1.1*) *Answer:* This problem is essentially one of measuring the flow rate of stock in each individual refiner or jordan. However, conventional flowmeters are either too expensive or undependable, or both. In this case, though, it is possible to measure the flow rate very simply by measuring the kilowatts (or equivalent) drawn by the motor and the temperature rise of the stock as it passes through the refiner or jordan. Since in a normal jordan about 90% of the power supplied shows up as heat in the exit stock, this provides a rapid, handy, and cheap method of balancing the flow through parallel refiners. As an example, we have a bank of four refiners lined up in parallel, with very unbalanced piping to the various units. There are resistance thermometer bulbs in the inlet stock and in the outlet stock from each refiner. A multipoint recorder records the temperature rise across each of the units. Indicating wattmeters serve to split up the electrical load properly. When each refiner is drawing the same power and shows the same temperature rise, the system is balanced. Adjustments are made in plug setting and throttle valves to bring this about.

Incidental advantages of this system are that it provides a record of operation of each refiner, a record of the work done on the stock in terms of horsepower days per ton or any other convenient units, and a method of detecting any disturbing influences such as hot bearings, etc. We found the accuracy to be within about ±5%, our standard error of estimate being about 2.5%.

(*2*) *Question:* Will lead gasketing in a fabricated stainless steel pulper stand up to hot dilute caustic in the repulping of wet-strength waste?

(*2.1*) *Answer:* We have encountered in our pulper extremely rapid corrosion of the lead under these conditions. The lead has dissolved right out of the joints causing severe leakages, and finally forcing us to weld all the joints up solid.

(*3*) *Question:* We have experienced difficulty in obtaining reliable level recordings in 8 to 12% consistency kraft stock storage chests. What method of level measurement is recommended for this application?

(*3.1*) *Answer:* It is recommended that a flange type of level transmitter be mounted on the tank or chest at the desired depth. The mounting nipple should be as short as possible and a 1-in. "Dutchman," drilled and tapped for a 1/2-in. water purge, should be mounted between the mounting flange and the transmitter. It may be desirable to mount a cut-off valve to permit the removal of the transmitter during operation. If so, the thin "guillotine" type of stock valve is recommended.

The transmitter should be mounted at the dilution level in the chest, and a supply of clean purge water provided. The transmitted signal may be indicated or recorded. This system has proved satisfactory for high consistency kraft stock.

(*4*) *Question:* What is the basic consideration used in choosing a synchronous motor for a particular drive in preference to an induction motor?

(*4.1*) *Answer:* I believe the answer to this question that can be found in "A Preliminary Report of the TAPPI Electrical Subcommittee—Selection of Electric Motors for Paper Mill Application"; Volume 33, No. 12, December 1950.

The following pertains to synchronous motors:

"Synchronous motors are sometimes used because of their constant speed characteristics. The primary reason for selecting them over induction motors, however, may be because of any one of the following advantages:

"1. The initial cost is lower in (a) ratings below 500 r.p.m., above 50 hp., (b) very large horsepower rating, that is, 500 to 1000 hp. and above at medium speeds (500 to 900 r.p.m.).
"2. They operate at unity or a leading power factor thus improving the power factor of the average plant at low cost per corrective kva. supplied.
"3. The efficiency of low-speed synchronous motors and unity power factor high-speed synchronous motors is higher.
"4. Large air gap—two to three times that of an induction motor. This is a distinct advantage in direct connected drives, particularly where the motor is furnished without shaft and bearings.
"5. Lower starting current.
"6. Special starting characteristics do not affect running efficiency as they do in induction motors."

(*5*) *Question:* Ten months ago we installed a 6 ft. 0 in. diam. agitator impeller made of 1 in. thick, mild steel in our machine chest and have been operating it at a speed of 41 r.p.m. The outer 18 in. of this impeller have worn, washed, or corroded away leaving a rough, bumpy, and pitted surface. This has been a surprise to us for our stock is not abrasive nor particularly corrosive to mild steel. The hub of the impeller shows little corrosion. What material would you suggest be used in a replacement impeller to inhibit this corrosion?

(*5.1*) *Answer:* From your description of the impeller, it is our opinion that the impeller has not failed due to either corrosion or abrasion, but failed due to cavitation. Cavitation is the phenomena wherein, due to turbulence, a liquid flowing around a solid creates air bubbles along the surface of the solid as the surface passes through areas of negative pressure. The bubbles are then collapsed when conditions of positive pressure occur, and the surface is thereby subjected to a pounding and a reversal of stress. Where the bubbles are small and the speed of build-up and collapse of the bubble is high, these stresses assume a formidable magnitude and the number of reversals of stress soon exceed the endurance limit of the metal. The surface then fails in shear from fatigue fractures over small areas and is progressively consumed. Since the fatigue value of all common metals is relatively the same, the solution to this problem does not lie in changing the material but in changing the design of the part to eliminate the cavitation. This change will also probably reduce the horsepower input to the impeller or increase the circulation in the chest with the same horsepower input.

**Fourteenth**
**Engineering Conference**
**TAPPI**

**Penn-Sheraton Hotel, Pittsburgh, Pa.**
**Oct. 12–15, 1959**

# Current Status of Alkaline Digester Corrosion as Reported by Regional Digester Group

H. M. CANAVAN

IN PREPARING this fourth report covering regional digester activity, TAPPI mill report forms from thirty (30) mills were used, which include 197 carbon steel, stainless steel and Inconel, lined or clad, digesters.

Reports were received covering 168 carbon steel digesters and 29 stainless steel and Inconel lined or clad digesters. The corrosion rates found in the current data correspond closely with those reported in previous studies.

Table I shows the average current corrosion rate and average corrosion rate in the critical area of carbon steel digesters for individual mills. Tables II and III provide the same information for Inconel and stainless steel lined or clad digesters.

The supporting corrosion data contained in questions 17 through 27, inclusive, of the mill report form was summarized as follows:

*Question 14:* Location of critical area?

| | *Upper shell, %* | *Middle shell, %* | *Lower shell, %* | *Top head, %* | *Bottom head, %* | *No, critical area, %* |
|---|---|---|---|---|---|---|
| 1958 | 31.9 | 28.4 | 8.62 | 7.1 | 7.1 | 5.6 |
| 1957 | 23.4 | 37.3 | 18.9 | 5.0 | 9.4 | 6.0 |
| 1956 | 36.5 | 40.9 | 7.6 | 2.5 | 3.1 | 9.4 |
| 1955 | 23.9 | 53.1 | 5.2 | 9.5 | 2.3 | ... |

*Question 15:* Has critical area moved since last inspection?

| | *Yes, %* | *No, %* |
|---|---|---|
| 1958 | 17.8 | 82.2 |
| 1957 | 20.8 | 79.3 |
| 1956 | 22.8 | 77.2 |
| 1955 | 14.8 | 85.2 |

*Question 18:* Method of estimation used:
Numerical—19 mills or 63.5% Graphical—None

*Question 19:* Has the average current corrosion rate changed since last inspection?

| | *Decreased, %* | *Increased, %* | *No change, %* | *Don't know, %* |
|---|---|---|---|---|
| 1958 | 24.3 | 28.9 | 19.8 | 27.0 |
| 1957 | 40.7 | 17.5 | 21.7 | 20.1 |
| 1956 | 33.1 | 31.8 | 26.3 | 8.8 |
| 1955 | 26.7 | 44.6 | 13.9 | 14.8 |

H. M. Canavan, Mutual Boiler and Machinery Insurance Co., Waltham, Mass., chairman of Subcommittee on Digester Corrosion Evaluation has submitted the annual report of his committee.

Mr. Canavan regretfully reported that some mills, which had submitted data for earlier reports, indicated a lack of continuing interest in this project. The absence of this information, while not greatly influencing the general conclusions of this current report, could seriously detract from the usefulness of the information developed in the future if it were to continue.

At the same time, however, additional mills have become interested and are participating in the program. The engineers in some of the mills are still very interested in the program and have submitted suggestions relative to changing the digester mill report form to include additional information which they feel is desirable. These changes have been submitted to the committee. for study.

H. M. CANAVAN, Chief Inspector-Boiler Div., Mutual Boiler and Machinery Insurance Co., Waltham 54, Mass.

**Table I. Current Corrosion Rates for Digesters—Carbon Steel**

| *Mill code* | *Number of digesters* | *Mill average corrosion rate, mils/yr.* | *Mill average corrosion rate critical area, mils/yr.* |
|---|---|---|---|
| A | No reports | ... | ... |
| B | 2 | 23.0 | 27.0 |
| C | No reports | ... | ... |
| D | No reports | ... | ... |
| E | 13 | 65.8 | 165.0 |
| F | 8 | 42.0 | 58.0 |
| G | 5 | 48.0 | 85.0 |
| Gl | 5 | 26.0 | 76.0 |
| H | 6 | [a] | 75.0 |
| Hl | 4 | 63.0 | 65.0 |
| I | 6 | 13.0 | 36.0 |
| J | No reports | ... | ... |
| K | 5 | 51.0 | 81.0 |
| Kl | No reports | ... | ... |
| L | 5 | 38.0 | 66.0 |
| M | 5 | 100.0 | 260.0 |
| Ml | 10 | 7.0 | [a] |
| N | 24 | 22.0 | 84.0 |
| O | 5 | 32.0 | 48.0 |
| P | No reports | ... | ... |
| Q | 30 | 7.0 | 41.0 |
| Ql | 3 | 15.0 | 9.0 |
| R | 8 | 32.0 | 97.0 |
| Rl | 11 | 38.0 | 32.0 |
| U | No reports | ... | ... |
| V | No reports | ... | ... |
| W | No reports | ... | ... |
| Wl | 6 | [a] | [a] |
| X | 1 | 34.0 | 34.0 |
| Z | 6 | 2.2 | 1.5 |
| | Total 168 | | |
| | Weighted average | 28.2 | 69.1 |
| | Median | 22.0 | 60.0 |

[a] Thickness measurement omitted from report.

*Question 21:* Has the current corrosion rate at the critical area changed since last inspection?

| | *Decreased, %* | *Increased, %* | *No change, %* | *Don't know, %* |
|---|---|---|---|---|
| 1958 | 22.3 | 29.4 | 20.8 | 27.5 |
| 1957 | 36.5 | 26.6 | 18.2 | 18.7 |
| 1956 | 37.2 | 34.4 | 22.3 | 6.1 |
| 1955 | 30.4 | 39.3 | 15.7 | 14.6 |

*Question 23:* Is a current change in general corrosion indicated by visual inspection only?

| | *Decreased, %* | *Increased, %* | *No change, %* | *Don't know, %* |
|---|---|---|---|---|
| 1958 | 11.2 | 1.01 | 50.8 | 37.09 |
| 1957 | 5.3 | 7.9 | 76.3 | 10.5 |
| 1956 | 7.3 | 12.6 | 72.2 | 7.9 |
| 1955 | 10.1 | 10.1 | 63.6 | 16.2 |

**Table II. Current Corrosion Rates for Digesters—Inconel, Lined or Clad**

| *Mill code* | *Number of digesters* | *Mill average corrosion rate, mils/yr.* | *Mill average corrosion rate critical area, mils/yr.* |
|---|---|---|---|
| B | 1 | 0.0 | 8.0 |
| N | 4 | 1.0 | 1.0 |
| T | 6 | [a] | [a] |
| | Total 11 | | |
| | Weighted average | 0.8 | 2.4 |
| | Median | 1.0 | 2.0 |

[a] Thickness measurement omitted from report.

**Table III. Current Corrosion Rates for Digesters—Stainless Steel 316 and 347, Lined or Clad**

| *Mill code* | *Number of digesters* | *Mill average corrosion rate, mils/yr.* | *Mill average corrosion rate critical area, mils/yr.* |
|---|---|---|---|
| B | 2 | 1.0 | 3.0 |
| N | 1 | 5.7 | 7.0 |
| O | 1 | 17.9 | 23.1 |
| S | 8 | 2.2 | 3.1 |
| T | 3 | [a] | [a] |
| Y | 3 | [a] | [a] |
| Total | 18 | | |
| Weighted average | | 3.6 | 5.07 |
| Median | | 1.0 | 3.0 |

[a] Thickness measurement omitted from report.

*Question 24:* Is a current change in localized attack indicated by visual inspection only?

| | *Decreased, %* | *Increased, %* | *No change, %* | *Don't know, %* |
|---|---|---|---|---|
| 1958 | 9.18 | 7.1 | 50.1 | 33.62 |
| 1957 | 4.5 | 12.5 | 73.0 | 10.0 |
| 1956 | 10.6 | 8.6 | 74.8 | 6.0 |
| 1955 | 4.0 | 7.1 | 75.8 | 13.1 |

*Question 26:* Location of unscaled areas.

| | *Top head, %* | *Upper shell, %* | *Middle shell, %* | *Lower shell, %* | *Bottom head, %* |
|---|---|---|---|---|---|
| 1958 | 56.2 | 58.3 | 41.6 | 31.0 | 58.8 |
| 1957 | 19.8 | 18.1 | 24.0 | 18.5 | 19.6 |
| 1956 | 23.4 | 21.8 | 20.5 | 11.2 | 23.1 |
| 1955 | 21.2 | 18.9 | 22.7 | 17.3 | 19.9 |

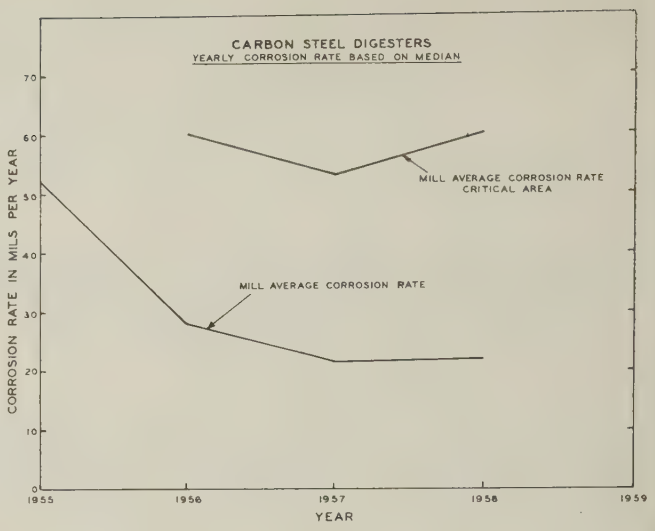
*Question 27:* Changes made since last inspection which might affect corrosion rate.
No changes were reported except the use of overlay.

The cause of corrosion in the critical area was summarized as follows:

| | *1958* | *1957* | *1956* |
|---|---|---|---|
| Liquor charging, % | 24.4 | 23.9 | 30.1 |
| Liquor circulating, % | 6.6 | 15.3 | 15.5 |
| Normal corrosion, % | 12.2 | 9.4 | 10.3 |
| Chip impingement, % | None | 10.2 | 8.2 |
| Chip contour, % | None | 3.9 | 7.3 |
| All other causes, % | 14.2 | 6.3 | 11.8 |
| Don t know, % | 43.5 | 31.0 | 16.8 |

The average current corrosion rate for 168 carbon steel digesters ranged from 2.2 to 100 mils per yr. with a median of 22.0 mils per yr. as compared with 21.5 mils per yr. in 1957. The average corrosion rate in the critical area ranged from 1.5 to 260 mils per yr. with a median of 60 mils per yr.

Reports covering 11 Inconel lined or clad digesters were reviewed, but due to lack of information it was only possible to establish corrosion rates on five digesters. The mill average corrosion rate averaged from 0 to 1.0 mil per yr., with a weighted average of 0.8 mils per yr. and a median of




1.0 mil per yr. Reports covering 18 stainless steel lined or clad digesters were studied, but due to insufficient information the corrosion rates had to be based on 12 digesters. The mill average current corrosion rate ranged from 1 to 17.9 mils, with a weighted average of 3.6 mils and a median of 1 mil.

The critical area in the carbon steel digesters was located in the upper shell in 31.9% of the digesters and in the middle shell in 28.4% of the digesters. It appears the critical area is now located in the upper shell as compared with the middle shell for the last 3 years. In 82.2% of the digesters the critical area has not moved as compared with 79.3% in 1957.

## OVERLAY WELDING

Fourteen mills reported using overlay welding in 61 digesters to retard corrosion and to extend the useful life of existing digesters. This is an increase of over 50% of the digesters recorded in 1957. The approximate areas covered varied from 1 sq. ft. to 1750 sq. ft. or the entire shell section of some of the digesters.

The overlay was located as follows:

| *Upper shell, %* | *Middle shell, %* | *Lower shell, %* | *Bottom head, %* | *Critical area, %* | *Top head* |
|---|---|---|---|---|---|
| 29.5 | 32.8 | 42.5 | 42.5 | 18.1 | None |

Table IV shows the overlay welding which has been carried out and the comments received from the mills.

The mills reported as follows:

95% reported no cracking, while 4.9% had trouble with cracking.

54% reported the corrosion rate decreased and 27.4% did not know.

65.5% reported the overlay as satisfactory, while 6.5% reported they were having some trouble with it.

**Table IV**

| *Mill code* | *Material used* | *Length of service, months* | *Did corrosion rate change?* | *Did cracking occur?* | *Are results satisfactory?* | *Did corrosion rate adjacent to base metal change?* | *Area covered, sq. ft.* |
|---|---|---|---|---|---|---|---|
| E | 310 SS | 5 | Decreased | No | No comment | No comment | 25 |
| G | 310 SS | 11 | No comment | No | Yes | Decreased | 100 |
| Gl | No. 7 carbon steel | 36 | Decreased | No | Yes | Don't know | 10 |
| H | 310 SS | 2 to 5 | Don't know | No | Yes | Don't know | 710 |
| Hl | 310 SS | 6 to 12 | Don't know | Slight surface | Don't know | No change | 675 to 728 |
| L | Carbon steel | 1 to 24 | Decreased | No | Yes | No change | 24 to 60 |
| M | 310 SS | 8.5 to 10 | Decreased | No | Yes | Increased | 17 to 20 |
| N | 310 SS | 5 to 30 | Decreased, | No | Yes | Increased | |
| | Carbon steel | 3 to 6 | don't know | No comment | No comment | Don't know | 1 to 22.5 |
| Q | 310 SS | 6 to 36 | Decreased | No | Yes | Increased | 8 to 415 |
| Ql | 310 SS | 18 | Decreased | No | Yes | Don't know | 1106 |
| Rl | 310 SS | 24 | Decreased | No | Yes | No change | 85 |
| S | 316 LC | 6 | Decreased, | No | Yes | No change | 4 |
| | 310 SS | No comment | no comment | No comment | No comment | ..... | 2 |
| Wl | 316 SS | 1 to 9 | No comment | No | No | No change | 1750 |

Where areas were overlayed 29.4% reported an increase in the corrosion rate of the parent metal adjacent to the overlay. 4.9% reported the rate decreased.

## SUMMARY

The following conclusions are based on the data submitted:

1. The average current corrosion rate for carbon steel digesters, based on the median, has increased from 21.5 mils to 22.0 mils per yr.

2. The average current corrosion rate in the critical area of carbon steel digesters, based on the median, has increased from 53 mils to 60 mils per yr.

3. The critical area appears to have moved to the upper shell, while the percentage of the mills reporting the critical area in the middle shell has decreased from 37.3% to 28.4%. This decrease in percentage may, possibly, be due to the stainless steel overlay welding that is being done on the middle and upper shells.

4. It appears liquor charging is still leading the list of of causes for corrosion in the critical area. However, a large number of mills are still reporting that they do not know the cause of the corrosion in the critical area. It appears that if this percentage could be decreased we would have a better balance as to the cause of the corrosion in the questionable areas.

5. It is interesting to note that the average corrosion rate for all carbon steel digesters, based on the median, is 22.0 mils as compared with 1.1 mils for the alloy lined and clad digesters. The average corrosion rate for the critical area for all carbon steel digesters, based on the median, is 60 mils as compared with 2.0 mils for lined and clad digesters. The average corrosion rate for carbon steel digesters versus lined and clad digesters, based on the weighted average, is 28.2 mils as compared with 3.6 mils.

The excellent reponse from the contributing mills and the cooperation and assistance received from the Regional Committee Members are gratefully acknowledged.

## *Chemical Engineering Committee— Progress Report No. 1 on Project No. 626*

The Chemical Engineering Committee of TAPPI's Engineering Division has undertaken an educational promotion program concerning chemical engineering in the pulp and paper industry.

The purposes of the program are fourfold:

1. To assure a future supply of chemical engineers for the pulp and paper industry.
2. To stimulate interest of Chemical Engineering Departments in the technology of pulp and paper manufacture.
3. To encourage the inclusion of problems, discussions, and examinations on pulp and paper technology in current chemical engineering curricula.
4. To expand fundamental and design data by increasing sponsored research in widespread Chemical Engineering Departments.

The first approach was to determine the number of chemical engineers holding formal degrees employed in the pulp and paper industry. Accordingly, arrangements were made to send a questionnaire to pulp and paper mills in the United States seeking this information.

The cooperation of the American Paper and Pulp Association was sought and gratefully received in the form of a letter to the industry endorsing the project and urging that the requested information be supplied.

Substantial progress has been made on the initial phase of this program and it is the purpose of this report to indicate the results obtained to date on the chemical engineers employed by the industry.

Questionnaires were distributed to 792 pulp and paper mills in the United States. Replies were received from 235 companies (264 mills) which corresponded to a 33% return.

**Table I. Questionnaire Returns Showing Respondent Mill by Code Number and the Number of Graduate Chemical Engineers Employed by Each**

| Mill code no. | Degrees granted B.S. | M.S. | Ph.D. | Mill code no. | Degrees granted B.S. | M.S. | Ph.D. |
|---|---|---|---|---|---|---|---|
| 1 | 1 | .. | .. | 86 | 11 | .. | .. |
| 2 | .. | .. | .. | 87 | 1 | .. | .. |
| 3 | 4 | .. | .. | 88 | 1 | .. | .. |
| 4 | 5 | .. | .. | 89 | .. | .. | .. |
| 5 | 1 | .. | .. | 90 | 4 | 1 | 1 |
| 6 | 5 | .. | .. | 91 | 4 | .. | .. |
| 7 | 5 | .. | .. | 92 | .. | .. | .. |
| 8 | 1 | .. | .. | 93 | 4 | .. | .. |
| 9 | 1 | .. | .. | 94 | .. | .. | .. |
| 10 | .. | .. | .. | 95 | 3 | .. | .. |
| 11 | 1 | .. | .. | 96 | .. | .. | .. |
| 12 | .. | .. | .. | 97 | 9 | .. | .. |
| 13 | 2 | .. | .. | 98 | 5 | .. | .. |
| 14 | 1 | .. | .. | 99 | .. | .. | .. |
| 15 | .. | .. | .. | 100 | 2 | .. | .. |
| 16 | .. | .. | .. | 101 | .. | .. | .. |
| 17 | 3 | .. | .. | 102 | .. | .. | .. |
| 18 | 2 | .. | .. | 103 | 2 | .. | .. |
| 19 | 3 | .. | .. | 104 | 3 | .. | .. |
| 20 | 3 | .. | .. | 105 | .. | .. | .. |
| 21 | 5 | 1 | .. | 106 | .. | .. | .. |
| 22 | 4 | .. | .. | 107 | 1 | .. | .. |
| 23 | 3 | 1 | .. | 108 | 5 | 6 | .. |
| 24 | .. | .. | .. | 109 | 1 | .. | .. |
| 25 | .. | .. | .. | 110 | .. | .. | .. |
| 26 | .. | .. | .. | 111 | .. | .. | .. |
| 27 | 4 | .. | .. | 112 | .. | .. | .. |
| 28 | 3 | .. | .. | 113 | 1 | .. | .. |
| 29 | 7 | .. | .. | 114 | 3 | .. | .. |
| 30 | 4 | 3 | .. | 115 | 1 | .. | .. |
| 31 | 3 | .. | .. | 116 | .. | .. | .. |
| 32 | 1 | .. | .. | 117 | .. | .. | .. |
| 33 | 1 | .. | .. | 118 | 1 | .. | .. |
| 34 | 7 | 6 | .. | 119 | 1 | .. | .. |
| 35 | 19 | .. | 1 | 120 | 2 | 2 | .. |
| 36 | 1 | .. | .. | 121 | .. | .. | .. |
| 37 | 4 | .. | .. | 122 | .. | .. | .. |
| 38 | 1 | 1 | .. | 123 | 7 | .. | .. |
| 39 | 2 | .. | .. | 124 | 13 | 1 | .. |
| 40 | 13 | .. | .. | 125 | .. | .. | .. |
| 41 | .. | .. | .. | 126 | 2 | .. | .. |
| 42 | .. | .. | .. | 127 | 7 | .. | .. |
| 43 | .. | .. | .. | 128 | .. | .. | .. |
| 44 | 1 | .. | .. | 129 | 1 | .. | .. |
| 45 | 1 | .. | .. | 130 | 1 | .. | .. |
| 46 | 1 | .. | .. | 131 | 15 | 1 | .. |
| 47 | 3 | .. | .. | 132 | 6 | .. | .. |
| 48 | 3 | .. | .. | 133 | 8 | 3 | .. |
| 49 | 8 | .. | .. | 134 | 13 | 1 | .. |
| 50 | .. | .. | .. | 135 | 20 | 3 | 2 |
| 51 | .. | .. | .. | 136 | 4 | .. | .. |
| 52 | 2 | .. | .. | 137 | 35 | 3 | 1 |
| 53 | 1 | .. | .. | 138 | 1 | .. | .. |
| 54 | 2 | .. | .. | 139 | 61 | 9 | 1 |
| 55—See 242 | | | | 140 | 10 | .. | 1 |
| 56 | 17 | 3 | .. | 141 | 7 | .. | .. |
| 57 | 1 | .. | .. | 142 | 10 | .. | .. |
| 58 | 1 | .. | .. | 143 | 17 | 3 | .. |
| 59 | 2 | .. | .. | 144 | 6 | 3 | .. |
| 60 | 6 | .. | .. | 145 | 2 | 1 | .. |
| 61 | 2 | .. | .. | 146 | 3 | .. | .. |
| 63 | .. | .. | .. | 147 | .. | .. | .. |
| 64 | .. | .. | .. | 148 | 6 | 1 | .. |
| 65 | .. | .. | .. | 149 | 4 | .. | .. |
| 66 | .. | .. | .. | 150 | 10 | 3 | .. |
| 67 | 4 | 1 | .. | 151 | 7 | 3 | 1 |
| 68 | 2 | 5 | .. | 152 | 3 | .. | .. |
| 69 | 1 | .. | .. | 153 | 5 | 1 | .. |
| 70 | 2 | .. | .. | 154 | 1 | .. | .. |
| 71 | .. | .. | .. | 155 | 3 | 1 | .. |
| 72 | .. | .. | .. | 156 | 1 | .. | .. |
| 73 | 1 | 3 | .. | 157 | 1 | .. | .. |
| 74 | 2 | .. | .. | 158 | 2 | 2 | .. |
| 75 | 1 | .. | .. | 159 | 77 | 18 | 1 |
| 76 | 3 | .. | .. | 160 | 8 | .. | .. |
| 77 | 2 | .. | .. | 161 | 9 | 3 | .. |
| 78 | 1 | .. | .. | 162 | 1 | .. | .. |
| 79 | 12 | .. | .. | 163 | 15 | 1 | .. |
| 80 | 1 | .. | .. | 164 | 43 | .. | 3 |
| 81 | .. | .. | .. | 165 | 4 | .. | .. |
| 82 | .. | .. | .. | 166 | 5 | 2 | .. |
| 83 | 1 | .. | .. | 167 | 1 | .. | .. |
| 84 | 2 | .. | .. | 168 | 11 | 8 | .. |
| 85 | .. | .. | .. | 169 | 6 | 1 | .. |

**Table I (*Continued*)**

| Mill code no. | Degrees granted B.S. | M.S. | Ph.D. | Mill code no. | Degrees granted B.S. | M.S. | Ph.D. |
|---|---|---|---|---|---|---|---|
| 170[a] | 5 | .. | .. | 212 | .. | .. | .. |
| 180[a] | .. | .. | .. | 213 | .. | .. | .. |
| 181 | 13 | 1 | .. | 214 | 2 | .. | .. |
| 182 | 3 | .. | .. | 215 | .. | .. | .. |
| 183 | 3 | .. | .. | 216 | 5 | .. | .. |
| 184 | 3 | .. | .. | 217 | 29 | 3 | .. |
| 185 | 1 | .. | .. | 218 | 39 | 8 | 4 |
| 186 | 9 | .. | .. | 219 | 5 | .. | .. |
| 187 | 11 | 1 | .. | 220 | 3 | 1 | .. |
| 188 | 5 | .. | .. | 221 | .. | .. | .. |
| 189 | 16 | 2 | .. | 222 | 22 | 5 | 2 |
| 190 | 2 | .. | .. | 223 | 5 | .. | .. |
| 191 | .. | .. | .. | 224 | 8 | .. | .. |
| 192 | 3 | 2 | .. | 225 | 45 | 4 | 2 |
| 193 | 1 | .. | .. | 226 | 4 | .. | .. |
| 194 | 1 | .. | .. | 227 | 2 | .. | .. |
| 195 | 7 | 1 | .. | 228 | 20 | 2 | 1 |
| 196 | 5 | 1 | .. | 229 | 5 | 3 | .. |
| 197 | 2 | .. | .. | 230 | 1 | .. | .. |
| 198 | 2 | .. | .. | 231 | 2 | .. | .. |
| 199 | 1 | .. | .. | 232 | 7 | .. | .. |
| 200 | 4 | .. | .. | 233 | 1 | .. | .. |
| 201 | 9 | 4 | .. | 234 | 3 | 1 | .. |
| 202 | 3 | .. | .. | 235 | 36 | 7 | 1 |
| 203 | .. | .. | .. | 236 | 4 | .. | 1 |
| 204 | 15 | 2 | .. | 237 | 2 | .. | .. |
| 205 | 2 | .. | .. | 238 | 29 | 3 | .. |
| 206 | 1 | .. | .. | 239 | 4 | .. | .. |
| 207 | 3 | .. | .. | 240 | 2 | .. | .. |
| 208 | .. | .. | .. | 241 | 4 | .. | .. |
| 209 | .. | .. | .. | 242 | 100 | 4 | .. |
| 210 | 38 | 7 | .. | 243 | 11 | 4 | .. |
| 211 | 7 | 2 | .. | 244 | .. | .. | .. |

[a] Numbers 171–179 not used.

Table I lists the respondent company (by code number) and shows the number of graduate chemical engineers with the corresponding degrees indicated employed by each respondent company.

The returns were divided into three categories: (1) paper mills only, (2) pulp and paper mills, and (3) unidentified mills. The number of each is as follows: 92 paper mills, 117 pulp and paper companies (146 mills), and 26 unidentified mills.

The category "paper mills" includes those mills who utilize market pulp, waste paper, or an equivalent raw material. The category "pulp and paper mills" includes pulp mills, integrated pulp and paper mills, hardboard mills, insulating board mills, and roofing felt mills. The category "unidentified mills" includes those mills whose identity was not indicated on the returns but the results provided are included in the several tabulations, excepting the tonnage figures subsequently shown.

The returns revealed a total of 1521 people with formal degrees in chemical engineering employed by the 264 respondent mills. The breakdown by the degree conferred is as follows: 1329 B.S., 171 M.S., 21 Ph.D.

These figures do not include graduates from The Institute of Paper Chemistry (Lawrence College) since the questionnaire did not ask that degrees earned prior to an advanced degree be shown together with the respective school which granted the degree. The returns showed, however, that 61 graduates from I.P.C. are employed by the respondent mills.

Similarly the figures do not include people who, the returns indicated, received a degree in chemical engineering from the New York State College of Forestry at Syracuse, N. Y. There were a total of 32 graduates so indicated as being employed by the respondent mills.

The breakdown of the number of graduate chemical engineers employed by each of the three categories of mills shown above is as follows:

**Table II. Questionnaire Returns Showing U. S. Schools and Numbers of Graduate Chemical Engineers in the Pulp and Paper Industry**

| U. S. schools | Degrees granted B.S. | M.S. | Ph.D. | Total |
|---|---|---|---|---|
| Akron, University of | 1 | .. | .. | 1 |
| Alabama Polytechnic Institute | 21 | 2 | .. | 23 |
| Alabama, University of | 31 | 2 | .. | 33 |
| American University | 1 | .. | .. | 1 |
| Arkansas, University of | 11 | 1 | .. | 12 |
| Armour Institute of Technology | 7 | 2 | .. | 9 |
| Boston University | 1 | 1 | .. | 2 |
| Brooklyn Polytechnic Institute | 8 | 1 | .. | 9 |
| Bucknell University | 5 | 2 | .. | 7 |
| Buffalo, University of | 2 | .. | .. | 2 |
| California Institute of Technology | 1 | 1 | .. | 2 |
| California, University of | 5 | 1 | .. | 6 |
| Carnegie Institute of Technology | 8 | .. | 1 | 9 |
| Case Institute of Technology | 2 | 1 | .. | 3 |
| Catholic University of America | 1 | .. | .. | 1 |
| Charleston, College of | 1 | .. | .. | 1 |
| Cincinnati, University of | 29 | 1 | .. | 30 |
| Clarkson College of Technology | 13 | .. | .. | 13 |
| Clemson Agricultural College | 12 | .. | .. | 12 |
| Colby College | 2 | .. | .. | 2 |
| Colorado, University of | 10 | .. | .. | 10 |
| Columbia University | 5 | 1 | .. | 6 |
| Cooper Union | 2 | .. | .. | 2 |
| Cornell University | 6 | 1 | 2 | 9 |
| Dayton, University of | 4 | .. | .. | 4 |
| Delaware, University of | 5 | 2 | .. | 7 |
| Detroit, University of | 3 | .. | .. | 3 |
| Drexel Institute of Technology | 7 | .. | .. | 7 |
| Florida, University of | 32 | 1 | .. | 33 |
| Georgia Institute of Technology | 52 | 2 | .. | 54 |
| Grove City College | 3 | .. | .. | 3 |
| Harvard University | .. | 2 | .. | 2 |
| Hobart College | 1 | .. | .. | 1 |
| Holy Cross College | 1 | .. | .. | 1 |
| Hopkins, Johns | 2 | .. | .. | 2 |
| Houston, University of | 2 | .. | .. | 2 |
| Idaho, University of | 4 | .. | .. | 4 |
| Illinois Institute of Technology | 7 | 1 | .. | 8 |
| Illinois, University of | 6 | 2 | 1 | 9 |
| Indiana Central College | 1 | .. | .. | 1 |
| Indiana Technical College | 2 | .. | .. | 2 |
| Indiana, University of | 2 | .. | .. | 2 |
| Iowa State College of Agriculture | 18 | 1 | 2 | 21 |
| Iowa, State University of | 1 | 1 | 1 | 3 |
| Kansas State College of Agric. and Applied Science | 6 | .. | .. | 6 |
| Kansas, University of | 3 | 1 | .. | 4 |
| Kentucky, University of | 1 | .. | .. | 1 |
| Lafayette College | 6 | .. | .. | 6 |
| Lehigh University | 17 | 1 | .. | 18 |
| Louisiana Polytechnic Institute | 16 | .. | .. | 16 |
| Louisiana State University and A&M College | 33 | 16 | 1 | 50 |
| Louisville, University of | 3 | .. | 1 | 4 |
| Maine, University of | 109 | 30 | .. | 139 |
| Marquette University | 10 | .. | .. | 10 |
| Maryland, University of | .. | .. | 1 | 1 |
| Massachusetts Institute of Technology | 49 | 18 | 3 | 70 |
| Massachusetts, University of | 4 | .. | .. | 4 |
| Miami, University of | 1 | .. | .. | 1 |
| Michigan College of Mining & Technology | 14 | 2 | .. | 16 |
| Michigan State University | 5 | 2 | .. | 7 |
| Michigan, University of | 20 | 3 | .. | 23 |
| Minnesota, University of | 25 | 3 | 1 | 29 |
| Mississippi State College | 7 | .. | .. | 7 |
| Mississippi, University of | 4 | .. | .. | 4 |
| Missouri School of Mines | 7 | 1 | .. | 8 |
| Missouri, University of | 4 | .. | .. | 4 |
| Montana State University | 6 | .. | .. | 6 |
| Newberry College | 1 | .. | .. | 1 |
| New Hampshire, University of | 2 | 1 | .. | 3 |
| New Mexico Inst. of Mining & Tech. | 1 | .. | .. | 1 |
| New York, College of the City of | 3 | 1 | .. | 4 |
| New York University | 4 | 1 | .. | 5 |
| North Carolina State College | 50 | 4 | .. | 54 |
| North Carolina, University of | 3 | .. | .. | 3 |
| North Dakota State School of Science | 1 | .. | .. | 1 |
| North Dakota State Normal & Ind. Coll. | 1 | .. | .. | 1 |
| North Dakota, University of | 4 | 1 | .. | 5 |
| Northeastern University | 18 | .. | .. | 18 |
| Northwestern College | 7 | .. | .. | 7 |
| Norwich University | 2 | .. | .. | 2 |
| Notre Dame, University of | 4 | 1 | .. | 5 |
| Ohio State, University of | 21 | 9 | 2 | 32 |

**Table II (*Continued*)**

| *U. S. schools* | *Degrees granted* B.S. | M.S. | Ph.D. | Total |
|---|---|---|---|---|
| Oklahoma, University of | 2 | .. | .. | 2 |
| Oregon State College | 36 | 1 | 1 | 38 |
| Pennsylvania State College | 25 | .. | 1 | 26 |
| Pennsylvania, University of | 5 | .. | .. | 5 |
| Pittsburgh, University of | 5 | .. | .. | 5 |
| Princeton University | 2 | .. | .. | 2 |
| Purdue University | 38 | 4 | .. | 42 |
| Rensselaer Polytechnic Institute | 28 | 3 | .. | 31 |
| Rice Institute | 2 | .. | .. | 2 |
| Rose Polytechnic Institute | 4 | .. | .. | 4 |
| Seattle University | 1 | .. | .. | 1 |
| Siena College | 2 | .. | .. | 2 |
| South, University of | 1 | .. | .. | 1 |
| South Carolina, University of | 11 | .. | .. | 11 |
| South Dakota School of Mines and Tech. | .. | 1 | .. | 1 |
| Southern California, University of | 1 | 1 | .. | 2 |
| Stanford University | 2 | .. | 2 | 4 |
| Swarthmore College | 1 | .. | .. | 1 |
| Tennessee, University of | 11 | 3 | .. | 14 |
| Texas A & M, College of | 13 | .. | .. | 13 |
| Texas Christian University | 1 | .. | .. | 1 |
| Toledo, University of | 1 | .. | .. | 1 |
| Tri-State College | 10 | .. | .. | 10 |
| Tufts College | 4 | .. | .. | 4 |
| Tulane University of Louisiana | 4 | .. | .. | 4 |
| Union University | 1 | .. | .. | 1 |
| Unidentified | 1 | .. | .. | 1 |
| Vanderbilt University | 6 | .. | .. | 6 |
| Villanova University | 1 | .. | .. | 1 |
| Virginia Polytechnic Institute | 20 | 1 | .. | 21 |
| Wake Forest College | 1 | .. | .. | 1 |
| Washington, State College of | 19 | 1 | .. | 20 |
| Washington, University of | 74 | 14 | .. | 88 |
| Washington University (Mo.) | 4 | .. | .. | 4 |
| Wayne University | 3 | .. | .. | 3 |
| Western Michigan College | 4 | .. | .. | 4 |
| Wichita, Municipal University of | 1 | .. | .. | 1 |
| Worcester Polytechnic Institute | 9 | 1 | .. | 10 |
| Wisconsin, University of | 71 | 9 | 1 | 81 |
| Yale University | 7 | .. | 1 | 8 |
| West Virginia University | 12 | 1 | .. | 13 |
| Syracuse University | 16 | 1 | .. | 17 |
| U.C.L.A. | 1 | .. | .. | 1 |
| Washington & Lee University | 1 | 1 | .. | 2 |
| Lowell Technological Institute | 1 | .. | .. | 1 |

| | *Mill category* | *B.S.* | *M.S.* | *Ph.D.* | *Total* |
|---|---|---|---|---|---|
| | 92 paper mills | 210 | 13 | 4 | 227 |
| | 146 pulp and paper mills | 1060 | 149 | 15 | 1224 |
| | 26 unidentified mills | 59 | 9 | 2 | 70 |
| Total | 264 mills | 1329 | 171 | 21 | 1521 |

The ranges, of the number of graduates employed, the median number, and the number of mills in each of the three categories employed no chemical engineering graduates is shown in the following table:

| *Mill category* | *Graduates employed* Range | Median | *No. of mills with no Ch.E. graduates* |
|---|---|---|---|
| 92 paper mills | 0–46 | 1–2 | 31 |
| 146 pulp and paper mills | 0–104 | 7–8 | 10 |
| 26 unidentified mills | 0–25 | 1–2 | 10 |

Estimates (1957 Lockwood ) were made of the production capacity of the mills involved in the survey in an attempt to establish an order-of-magnitude per cent of total U. S. production represented in this survey. These estimates are:

*Paper mills*

| | |
|---|---|
| 31 mills (no grad. chem. engrs.) | 1500 tons/day |
| 61 mills (241 grad. chem. engrs.) | 7700 tons/day |
| Total | 9200 tons/day |

**Table III. Questionnaire Returns Showing Foreign Schools and Numbers of Graduate Engineers in the U. S. Pulp and Paper Industry**

| *Foreign schools* | *Degrees granted* B.S. | M.S. | Ph.D. |
|---|---|---|---|
| Canadian | | | |
| Alberta, Univ. of | 2 | .. | .. |
| British Columbia Univ. | 5 | .. | .. |
| Manitoba Univ. | 1 | .. | .. |
| McGill Univ. | 5 | .. | .. |
| New Brunswick Univ. | 1 | .. | .. |
| Queens University | 8 | .. | .. |
| Saskatchewan Univ. | 1 | .. | .. |
| Toronto University | 11 | 1 | .. |
| Western Ontario Univ. | 1 | .. | .. |
| German | | | |
| Askar-von-Miller Polytechnic | 1 | .. | .. |
| Freiberg University | 1 | .. | .. |
| Polytechnical Institute | 1 | .. | .. |
| England | | | |
| Southland Mun. College | 1 | .. | .. |
| National College of Technology | 1 | .. | .. |
| Finland | | | |
| Finland University | .. | 2 | .. |
| Technical College of Tempera | 1 | .. | .. |
| Finland Institute of Technology | .. | 1 | .. |
| Sweden | | | |
| Chalmers Institute | 1 | .. | .. |
| Goteborgs Technical Institute | 1 | .. | .. |
| Laroverk at Norrkoping | 2 | .. | .. |
| Royal Engineering College | 1 | .. | .. |
| Royal University of Engineering | 1 | .. | .. |
| Stockholm Technical University | 2 | .. | .. |
| Unidentified | 1 | .. | .. |
| Tekniska Hogskolan | 1 | .. | .. |
| Poland | | | |
| Warsaw, University of | 1 | .. | .. |

*Pulp and Paper Mills*

| | |
|---|---|
| 10 mills (no grad. chem. engrs.) | 1800 tons/day |
| 136 mills (1210 grad. chem. engrs.) | 52200 tons/day |
| Total | 54000 tons/day |

Daily tonnage for U. S. 1957 (assuming 350 working days per year):

$$\frac{30.7 \text{ million tons}}{350 \text{ days}} = 87{,}700 \text{ tons/day}$$

Per cent of total U. S. production represented in this survey:

$$\frac{9200 + 54000}{87700} \times 100 = 72\%$$

It should be noted the production represented by 26 unidentified mills is not included in these figures.

There are 156 schools represented in the survey of which 24 are foreign. All U. S. schools represented by this survey are shown in Table II and similarly the foreign schools are listed in Table III. Those schools which the survey showed each having 20 or more graduate chemical engineers employed by the pulp and paper industry are listed in Table IV. The total number of such graduates is 932 or 60% of the total indicated by this survey. While the bulk of the chemical engineers employed by the pulp and paper industry appears to come from 21 schools, it also appears a large number of other schools can and do supply this industry with chemical engineers.

The following table summarizes the number of the schools and the number of degrees in each degree category as represented in this survey. There is some duplication of schools involved because some advanced degrees were earned at the same school which conferred the B.S. degree.

| *Number of schools granting degrees* | |
|---|---|
| 128 | 1329 B.S. |
| 73 | 171 M.S. |
| 16 | 21 Ph.D. |

Another interesting point developed by the survey is that

**Table IV. Questionnaire Returns Showing Schools with 20 or More Chemical Engineering Graduates Employed in the Pulp and Paper Industry**

| Schools | Degrees granted B.S. | M.S. | Ph.D. | Total |
|---|---|---|---|---|
| University of Maine | 109 | 30 | .. | 139 |
| University of Washington | 74 | 14 | .. | 84 |
| University of Wisconsin | 71 | 9 | 1 | 81 |
| Massachusetts Inst. of Technology | 49 | 18 | 3 | 70 |
| North Carolina State | 50 | 4 | .. | 54 |
| Georgia School of Technology | 52 | 2 | .. | 54 |
| Louisiana State University | 33 | 16 | 1 | 50 |
| Purdue University | 38 | 4 | .. | 42 |
| Oregon State College | 36 | 1 | 1 | 38 |
| University of Alabama | 31 | 2 | .. | 33 |
| University of Florida | 32 | 1 | .. | 33 |
| Ohio State University | 21 | 9 | 2 | 32 |
| Renssalaer Polytechnic University | 28 | 3 | .. | 31 |
| University of Cincinnati | 29 | 1 | .. | 30 |
| University of Minnesota | 25 | 3 | 1 | 29 |
| Pennsylvania State University | 25 | .. | 1 | 26 |
| University of Michigan | 20 | 3 | .. | 23 |
| Iowa State College | 18 | 1 | 2 | 21 |
| Alabama Polytechnic Institute | 19 | 2 | .. | 21 |
| Virginia Polytechnic Institute | 20 | 1 | .. | 21 |
| State College of Washington | 19 | 1 | .. | 20 |

20% of the mills reporting show no graduate chemical engineers employed. However, the production so represented is only 6% of the total indicated for the survey. This latter comment excludes the production associated with 10 unidentified mills employing no graduate chemical engineers.

Some points were verified by the survey. Briefly these are:

1. The interest shown by the industry for information of this kind is substantial and is revealed by the high per cent returns and per cent production represented in the survey.

2. More graduate chemical engineers per mill (or per unit annual production) are employed by the pulp mills and/or integrated pulp and paper mills.

3. Paper mills, *per se*, do not employ many graduate chemical engineers. Whether this is economically desirable is an interesting question.

A follow-up survey has been initiated to secure similar information from those mills which have not reported to date. A subsequent report will be issued when the additional information is available.

## *Graphic Arts Session*

***Wednesday Morning, Feb. 25, 1959***

The Graphic Arts Session of the 44th Annual Meeting of the Technical Association of the Pulp and Paper Industry convened at 9 o'clock, at the Hotel Commodore, New York, N. Y., Miss J. M. Fetsko, presiding.

Mr. W. D. Schaeffer presented his prepared manuscript, "Reproducibility Studies of Pick Measurements—Progress Report from TAPPI Research Project 130."

SAM GRASS: What considerations were given to humidity and temperature in connection with properties of the ink and absorption ability and moisture of the papers?

MR. SCHAEFFER: As I said when I started off, we acquired a considerable quantity of the tack rated inks. We made the common rheological measurements, such as "Inkometer" readings, yield values and viscosities and followed them with time. We packaged the inks in smaller containers, so that we had individual lots we could send out, but we knew they were taken from a common source.

There is some evidence that with time the thixotrophic—for want of a better word—nature of some of our inks is increasing. We thought this might be responsible for the trend toward lower picking speed, more severe picking occurring with time, let us say, in the 5-day study.

However, if we were to extrapolate most recent experience back to the day when we started this program, and say, "This trend is due to increase in thixotrophic qualities," we shouldn't have had any picking back in the original work.

The stocks were stored at constant temperature (73°F.) and constant humidity (50%). The samples were packaged in polyethlene wrappings for shipment to the various laboratories. We requested that they run the samples accordingly in these standard environments. Whether they could do so or not remains a moot point. Some of the sets of data have been run under the specified circumstances. In other cases they have not.

VOICE (Georgia Board Co.): Have you run any test to find how much difference a slight change in temperature makes on the tack rating on these inks? We know a slight change will affect the results on the IGT. Have you found correlation showing the effect of temperature on picking?

MR. SCHAEFFER: We have not run correlation curves on effective changes in picking speed to variations in environmental temperatures. We have run our rheological properties at different temperatures, and we certainly know that the rheological properties of the ink responds to changes in temperature.

The pick measurements were made under standard conditions. To get into the magnitude of variation in the results due to minor changes in environment was beyond the present scope of the program.

WILLIAM BOFELL: Were drying time characteristics compared to the inks used?

MR. SCHAEFFER: These are tack rated inks which do not dry.

MR. AYERS (Continental Can Co.): In the original outline I believe there was some reference to trying to tie the laboratory work in with commercial or production equipment. Was that able to be carried through or is that still to be done?

MR. SCHAEFFER: That remains to be done along with a lot of other things.

VOICE: Were the adhesives that were used in the coatings that were used in the coated papers known?

MR. SCHAEFFER: No sir.

MR. CUSHING: Is it possible that the variation in increased periods of time is due to something that happens in the making of the sheet? Do you have a long enough period of time? This seems to be a trend as time increases, and then the age of the paper, the length of time that it has been exposed to oxygen and the other environmental conditions may be affecting the results that you are getting.

MR. SCHAEFFER: This is also a variation that has been suggested. Certainly any variations of this type would vary with the composition, if you like, of the sheet coating or what have you. We know exactly when we received each stock. When it was made or when it was manufactured, we do not know in most cases.

As a consequence, we might attempt backward extrapolation, and if we did so, I am very much afraid we would be faced with the same situation that I suggested to another question, and that is, the sheet would have had to have out-of-this-world strength on the day it was made, a strength which I think would not be reasonable at all.

MR. CUSHING: If I could respond just again, we have had some experience in our laboratory using a standard coating raw stock, and preparing coatings in a manner which appears to be reasonably reproducible from time to time, and yet the pick resistance measured by the IGT continues to decrease with this same stock being held in a constant temperature, constant humidity room. This suggests to me that we have an aging problem within the raw stock, which is influencing the pick result that we are getting.

MR. SCHAEFFER: Over what aging period are you talking about?

MR. CUSHING: A period of several months now. I suspect we should throw this stock away and start with fresh stock.

Mr. Schaeffer: I would gather that over the first 6 months, at least, an aging phenomenon might occur. However, one should expect this aging curve to level off, if it does indeed assume significant proportions in the results.

Charles Borchers (Lithographic Technical Foundation): I would like to ask Mr. Cushing a question about the aging of paper. Is it your opinion that the weakening of paper through aging may have differences depending on whether the paper is in a pile form, in a skid form, or individual sheets hanging out in the air?

Mr. Cushing: We certainly have to consider that the sheet is porous. It can absorb oxygen. In many instances it is exposed in an environment where we have ultraviolet light. This is particularly true in constant temperature rooms. Everybody uses fluorescent lights which have a considerable quantity of ultraviolet, and it occurs to me that there is a possibility that all of these things are influencing our results.

We are beginning to use pieces of equipment which are sensitive enough to pick these things up. The Dennison wax doesn't differentiate, but with the IGT I begin to believe really can differentiate.

Dr. Zettlemoyer (Lehigh University): I just don't want us to get off on the wrong foot with this aging thing. It seems to me that we must remember that we are talking about variations over 5 days for paper that is some months old at least, and over 10 days in another case, and I don't believe such variations could be ascribed to aging.

Mr. Eddy: Would it be possible to obtain the composition of coatings on those sheets? It would be of great assistance in assessing the data.

Mr. Schaeffer: Nothing is impossible, I understand. We have so many manufacturers involved that I am sure management policies differ in this respect. I have reservations whether it can be done on all the stocks. I would say this with respect to the aging problem on a limited experience, we used a particular stock in the 10-day original study, and even before that in the familiarization study, and in the last round-robin test, a period of testing which involved roughly 10 months. In that period we have had quite consistent performance of this one stock.

We have had tremendous variations, as you observed, specifically on day to day results. On the average, however, on a particular instrument, on the IGT, for example, we have come out with the same type of average picking speed that we had in the first phase of the test program.

Voice: I am sure the whole industry is indebted to you, and I will feel even a little bit indebted if you will be good enough to say what the degree of picking was that was the end point on the coated stock.

Mr. Schaeffer: In all cases, and I think this has to be stressed in any evaluation of pick strength, the first evidence of picking was used. This can lead to a tremendous amount of scattering of the data. We do not deny this. One has to be somewhat arbitrary up to this point at least in the selection of an end point, and many people have what I think would be better specifications of the end point than we have used up to this time.

Chairman Fetsko: I would like to introduce Mr. Glassman, chairman of the Surface Strength Subcommittee. I am sure his comments will be quite of interest to you.

Mr. Glassman: On this business of end point, it is the opinion of the committee that a considerable amount of the scatter that did occur can be attributed to this point. We in our own laboratory checked the results using the exact procedure in this round-robin study, and also using our own procedure for the end point which involves looking at the end point under a stereo microscope and noting the minimum of 12 indications of actual pick, we found that the variability was reduced very, very considerably.

Another factor that we found reduced variability very considerably on the IGT tester and was also confirmed by laboratory 18 in the round-robin test, which had practically no variation from day to day, is the fact that they used the pendulum attachment rather than any of the high-speed attachments.

There are a number of other points which the committee feels can be isolated and will give very much reduced day to day variations because there are a number of laboratories who are getting very much less variation than the general average of the industry.

Some of these things we feel are related to the composition of the rollers. You will notice in the studies there are rubber rollers and glue glycerine rollers, and the results with the glue glycerine rollers are very much better than with the rubber.

The discriminatory power of the machine with rubber rollers is very much poorer. We have also found that there are at least two laboratories that do not use the distribution system at all that is provided with the IGT system and have devised a method of introduction the ink with a doctoring system not involving rubber or glue glycerine, and they claim this is an improvement. Your committee will look into these things.

We feel that these methods are capable of giving much greater or much less day to day variations than we have found up to the present. However, it is important to have established the exact conditions that exist as of today.

Lehigh has done an extraordinarily good job of pin-pointing the facts.

G. R. Sears presented his prepared manuscript, "A Study of the Surface Characteristics of Paper and Paper Board as they Relate to Printing Smoothness—Progress Report from TAPPI Research Project 139."

Dr. Zettlemoyer: I would like to ask two questions, if I may. One is this: would you expect the roughness index would be greater as the viscosity of the ink is increased? I realize that you are in a much lower viscosity range than would be used in actual printing. Mostly, of course, this is because shortness, whatever that is, increases with viscosity.

The second question is this: do you find that you can get significant differences with this interesting test among a series of samples from the same type of stock, because this is where I would think you would want to use the control method?

Dr. Sears: We haven't tried to duplicate the effect of the ink. I am sure there would be a different effect of viscosity.

The effect of viscosity I was looking for was something else than that. This is a laboratory test for the purpose of trying to get an evaluation of the mean depth of the contours on the paper surface, and we have to choose a liquid which is appropriate for that surface, not necessarily one appropriate for printing.

The hope is that if we compress the sheet in the nip, with anything like the pressure, local pressures or nip loads that might have any connection with printing at all, that even though we were pushing a pool of liquid ahead of the nip and spreading this, which is not at all like the printing process, that we might still get a useful characterization of the surface, even though we do not simulate the printing conditions. There is no doubt that the liquid we used has no connection with the behavior of ink in printing. I don't think for our purpose it is necessary.

Dr. Zettlemoyer: Do you get differences among samples?

Dr. Sears: Yes, we do. The samples were selected originally in order to give us a good spread. The committee felt, and we too, that we should demonstrate we can find big differences before we worry about the small ones.

There is no question that this is of no use to anybody unless we can differentiate between closely similar samples. That is the thing we hope to do next.

You will notice we differentiate between felt and wire side of the papers; they happen to correspond to the differences Kimberly Clark found on their printing tests. I wouldn't

take that as too much evidence, but we distinguished between the two sides of the sheet, at least in that case.

R. O. Ragan (Chicago Carton Co.): Have you considered the possibility of vacuumizing 0.0025 foil on to the paper surface, and then using your oil spread? We found that if you subject that to a good vaccum, that the contour assumed by the foil is almost identical to the contour of the paper, and you would be free of the absorptive factor of the paper itself.

Dr. Sears: That is a very good point. We are aware of the possibility of doing it, but we haven't done it.

One of the difficulties with this sort of thing would be to calibrate the metering surface. As long as we stayed with the glass plates, we could get the glass companies to give us a polish that is fairly smooth. When you change to the roll, you have to have a roll of excellent finish because you detect the roughness of the roll, as well as the roughness of the paper in this metering operation.

We tried a roll which had been plated and given a reasonable polish, and we demonstrated right away we were getting too much effect. We had it reground and refinished, and it immediately increased the pattern. You noticed the longest pattern length for paper was 35 cm., and aluminum foil is so long we can hardly handle it. We have managed to get them out as far as a meter and a half, but we couldn't do more.

A least the roll is smooth enough so that with the polished side of aluminum foil, we get polished lengths over a meter and a half. We haven't demonstrated we are measuring only the roughness contours of the paper and not some of those in the roll yet.

W. Verseput (Continental Can): In connection with this previous question about differences between samples, which differ only to a minor extent in printing quality, I would like to ask the cooperation of anyone here in this regard. As you know and realize, it is fairly easy to grab a bunch of sheets in regular production, but to get something like pairs of samples or triple sets which are known to vary in printing quality to only a minor degree is not as easy.

The committee wants to furnish Dr. Sears with this type of samples, and if any of you have an opportunity to gather these, if you would get in touch with Dr. Sears or myself, we would be glad to tell you what we require in the nature of samples. I think roughly we decided that we need something like 100 sheets, 24 by 30, in order to have sufficient samples to perform all the tests that we would like to do.

Mr. Anderson: Has the printing quality been definitely affected by the porosity of the sheets? Couldn't you find some information about this by weighing the amount of ink which was laid on the sheet?

Dr. Sears: I think we could, but we would need to use a different technique because we started with a fixed volume of liquid, so the total increase of volume would be the same for all sheets because we use a constant volume of liquids. Your technique involves always putting on the same mass, and therefore the same amount of liquid.

Mr. Rice: I would like to ask if you would think there is likely to be any change in this test with faster speeds?

Dr. Sears: Yes, there would be. There are several reasons for choosing the low speed, and they may not be good ones.

First of all, as you increase the speed, the nip load has to go up in order to doctor down to the hills. As you know, if you have a smooth surface, the thickness of the film you leave on the surface depends upon the viscosity, the speed, and the nip load, so that for a given nip load in terms of pounds per inch, as you go to high speeds you unavoidably leave a thicker film.

We wish to doctor down to the hilltops, and you never do, of course, except by going to tremendous loads. You always leave some film on. We think we were using speeds low enough, viscosities low enough, and nip loads great enough, so that we had a relatively thin film left on top of the hills, and, therefore, we were measuring principally the mean depth of the thing.

When you go the higher speeds, you definitely are going to get thicker films left on. As you go the higher speeds, the thickness of the film will increase slowly at first. From the point of absorption, it will be desirable, of course, to go to higher speeds. If you do that, then you will get into a situation where the penetration is influenced not primarily by capillary forces, but by the pressure developed in the liquid system.

At these very low speeds of a tenth of a centimeter or $^{3}/_{10}$'s of a centimeter per second, the hydrostatic pressure in the flooded nip is very low, so that the penetration is principally under capillary forces.

If we went to 10 or 20 or 30 times that speed, we would get into a point where we would be putting on hydrostatic pressure. That may not be bad necessarily.

Mr. Rice: Perhaps I am also asking do you guess that compressibility or smoothness would vary with this penetration?

Dr. Sears: Let us take compressibility. We certainly feel that compressibility would vary with the speed. As a generality, whenever we change speeds, there will be some dependency on speed due to the viscoelastic character of the paper. Therefore, when we try to measure the compressibility of paper by using a loaded caliper device such as Federal compressibility gage, and do it statically, we feel that it is likely that the change in thickness of the sheet with a given change in load is not what we would get if applied the load quickly or ran the sheets through a nip and applied it quickly.

I think the same thing applies here. To get up to those speeds where that becomes a very pronounced effect, to get this something beyond the simple laboratory stage, I think going up from a tenth of a centimeter to 1 cm. or 10 cm. wouldn't get up into that range. You have to get up into the normal print speeds, perhaps where that would become important. That is my guess.

Mr. Dunning (Abbott): You haven't mentioned or I don't recall your mentioning, Dr. Sears, anything about the film splitting of your liquid film, and what proportion of your liquid is left on your plate, glass, or roll?

Dr. Sears: We didn't make any measure of that sort. We felt it wasn't necessary for our purpose. To the extent that we were doctoring either with the glass plate or the roll, doctoring down to the hilltops, we don't care what happens after the sheet goes through the nip. The liquid can all stick on the roll or all stick on the paper, as long as it is going through the metering nip.

All we ask is that the volume of liquid we have is spread over an area of paper, and the top surface of that film, at the moment it goes through the nip, is about at the level of the hilltops.

Some of it fills in the contours. Some of it soaks in. All we say is that at the time it goes through the nip, we want to know what is going on. After that, we don't care, whether it sticks to the sheet or sticks to the roll, as long as it had to go through the nip; so whether you have a stationary doctoring device or rolling one with tension on the sheet originally, we tried to hold the glass plate still and have the backing roll pull it through. We had chattering. Then we used a long glass plate and cut a slot in the back of the platform, so the glass plate went through the hole in the table at the same rate the paper went through. I think there was no question that the film split occurs, but it doesn't enter into the metering process.

Mr. R. O. Ragan presented a prepared manuscript, "Photographic Examination of Paper and Paperboard Surfaces to Predict Halftone Printing Quality."

Chairman Fetsko: I would like to make a few comments about Mr. Ragan's photomacrographs.

As you may know, we have a printability research program at Lehigh, under the auspices of the Folding Paper Box Association of America. We evaluated every commerically available smoothness tester, and we found that the visual rating of the microphotographs correlated best with our printing smoothness test.

Shortly after the publication of the first paper, I received many inquiries on how the photomacrographs were taken. We therefore invited Mr. Ragan to come and tell you how we did it. We will dispense with questions because we are definitely running behind time.

Mr. R. W. Prince presented his prepared manuscript, "Some of the Factors Affecting the Printing Quality of Newsprint."

Mr. Schaeffer: Can you give us some idea of the significant levels for these correlation coefficients for the 600 tests?

Mr. Prince: I would like to yield to Dr. Duncan, our statistical man on this, if he is in the room.

Dr. Duncan: We did it for two hundred tests and 0.2 is about the significant point.

Voice: Was any correlation made between the comparative printability between wire and felt sides? Was there any distinct difference between the two sides?

Mr. Prince: That was made. Mr. Taylor, who is in charge of that program, may be able to say what that is offhand.

A. Taylor (ANPA): Approximately 0.9, in favor of the felt side.

Thomas Appleton (Marsh Co.): We want to comment about the effects of the supercalendaring newsprint on display here. We haven't gone into any scientific work as yet, but the samples show decided improvement in the printability of newsprint from the supering angle, and it is available at Booth 5 on the mezzanine floor, if you would like to see those made by the IPI, independent, for our purposes, testing.

Mr. Geffken (J. M. Huber): How is show-through measured?

Mr. Prince: With a Bausch & Lomb opacimeter. Instrument is set to read zero on black body, 10 (full scale) on white body. Ratio of unprinted reflectance to printed reflectance multiplied by 100 equals per cent show-through.

Mr. Lynne: What is the correlation between opacity and show-through?

Mr. Prince: 0.71.

Mr. Lynne: Are the instruments used for your tests generally available or are they special?

Mr. Prince: All instruments selected for the program are commercially available, although some are not accepted for TAPPI standards.

The session adjourned at twelve-fifteen o'clock.

## *Cylinder Board Session—Symposium on Cylinder Board Formation*

***Tuesday Afternoon, Feb. 24, 1959***

The Discussion Session of the Symposium on Cylinder Board Formation, of the 44th Annual Meeting of the Technical Association of the Pulp & Paper Industry, held at the Hotel Commodore, New York, N. Y., convened in the West Ball Room at 2:30 pm., G. T. Renegar, Container Corp. of America, Philadelphia, Pa., presiding.

Chairman Renegar: If the authors and the men who are going to discuss the various papers will please take their places as I call their names, we will get underway as soon as possible, and the papers will be reviewed in the order in which they were presented; Mr. Hoffman, of the Container Corp. of America; Mr. Barber of Diamond Gardner; Mr. Nicholson, of Federal Paper Board; Mr. Manogue, of Gibralter Corrugated Paper Co; Mr. Milne of Black-Clawson Co.; Mr. Yates, of Robertson Paper Box; Harry Hadley, of Diamond Gardner Corp.; Cletus D. Coffman, of Chesapeake Paperboard; T. S. Brookover, of Downingtown Paper Co.; and J. P. Weidner, of Container Corp. of America.

For the benefit of our people in the audience, these gentlemen will review these papers and state their opinion as to where they agree or disagree, and will ask questions of the authors. At the same time I have a few questions which were handed to me prior to lunch. If there are any more, I'll be very glad to have them.

Fred, do you want to discuss Mr. Hoffman's paper?

F. G. Barber: I would like to review two or three important areas of Mr. Hoffman's paper, which, of course, as you know, is how furnish affects formation. I will just read a little part that he started out with.

"Formation of stock on a cylinder machine has always been a rather nebulous property. Every papermaker has his own theories as to which stock will form best on his own machine, and these theories do not necessarily agree with those held by other papermakers."

That is a big mouthful, and if there ever was a truism, that's it. There are more people who have different ideas on what good formation is and how you get good formation than there are papermakers, it seems to me.

I missed Mr. Brookover's paper, but it seems to me that on the basis that he was going to talk on the need for a uniform measurement of formation, certainly that is something that is very important, and I think the majority of people working with paperboard machines certainly would agree with that.

Another thing that Mr. Hoffman mentioned was that formation may easily be confused with other properties. In fact, it would be pretty difficult, it seems to me, to actually separate it from many other properties that we need in a sheet of paperboard. I don't know that anybody really knows how to separate it. I might even pose that as a question for us to kick around later.

Then he commented that one of the more common conceptions of how furnish affects formation is that formation is solely by the length of fibers in the furnish. It certainly would be interesting to see if the majority of people believe that, or whether we have a lot of other theories and ideas on what real effect the length of fiber has on formation.

He pointed out that certain fibers appear in the form of blocks more readily and break apart less readily than others, and I would certainly suspect that when these particular types of fibers are mixed in combinations with others, as we all do in making paperboard—be it the top liner, the filler, the back liner, or what have you—perhaps the properties change even amongst the fibers that operate or react a certain way when they are by themselves.

And then, of course, there are the chemical additives that also affect fibers in different ways.

He suggests that there is one theory that the type or amount of lignin remaining in the fibers may affect their chemical flocking. Here is another area where I am sure there are a lot of different ideas and theories, and it may bring up questions.

Also, he has pointed out that there is no effective or widely accepted method developed for demonstrating the quality or formation of stock, and that emphasizes also what Mr. Brookover was to talk about. Until we have such a system, any study of formation is more or less groping in the dark, quoting Mr. Hoffman, and also it would be pretty well agreed by anyone in our company, anyway, in making up paperboard, and I think Harry Hadley pointed that thought out pretty well this morning. It's certainly comforting that other people are in the dark too, although it certainly doesn't solve any problems for us.

It certainly was most interesting to see the method that Mr. Hoffman had developed to demonstrate some basis for a comparison of formation. You couldn't see—I mean to mention this later, and I can't show you what we have here, but I think you will find that when this paper is published you

will be able to get a much better comparison of the particular grades of pulps or waste materials that he spoke of, where he has all of the photographs on one page. Putting them on the screen as he had to do certainly limited his presentation this morning, I'm sure, because what he sent to me was a photograph in which you can compare all the nine various pulps or waste materials at one time.

I thought it was very interesting that he pointed out to us that after making these samples and finding a comparison of the various pulps and waste materials on one machine, they turned around and tried the same materials again on a second paper machine, and found a pretty good correlation.

It is interesting that when I looked over the photographs, which, as I say, it's a little unfair for me to talk about when you haven't had the advantage to look at them too, that I didn't come up with exactly the same rating that he did.

He pointed out that this was all done on a visual basis, and I then checked the photograph with Duncan Brown, of our company, who has a pretty good reputation in the paperboard business, and he agreed pretty closely with my rating of the particular photographs, but I would daresay that if I had shown them to Harry Hadley, he probably would have rated them somewhat differently.

And he pointed out, and I think I mentioned it earlier, that in making paperboard practically all of our furnishes are a mixture or blending of several types of fibers, both pulps and waste paper, and of course this starts multiplying our problems with formation as well as problems in many other areas.

Among the various pulps that he listed, we have a problem with western bleached kraft. This is one of the poorest for both formation and with printing, but we have certain contractual obligations that cause us to use quite a bit of that pulp, so we are forced to be confronted with that quite frequently.

I might add a little emphasis by repeating, in short, his conclusions, which were that formation on a cylinder machine may be greatly changed by the furnish used. I don't think there's much of any argument on that score; and, of course, even of much greater importance is the definite need for the effective means for evaluating formation.

All in all, I think it was a very good paper, and it represents quite a lot of work on Mr. Hoffman's part and the others at the Wabash plant of Container Corp.

Chairman Renegar: Thank you, Fred, for a very excellent review. I wonder if you have any questions you would like to ask Mr. Hoffman.

Mr. Barber: I would be interested in knowing how you go at trying to separate what is formation from other properties in a sheet. How did you narrow it down to just the formation aspect?

L. V. Hoffman: As I tried to point out this morning, it's very difficult to separate formation from these other properties. It's almost impossible to do it by looking at a finished sheet of board. The only way that we tried to do it a little bit was by breaking it down to single ply, and then passing a projected light through it, which gives you at least a little better opportunity to study formations; but it is very difficult to break it down completely.

Mr. Barber: I would expect, too, that looking at those slides that way where you shine a light through them, you would get a different effect than perhaps, you do when we look at photographs.

Mr. Hoffman: That's definitely true. The photographs were made from the slides. However, the slides were taken with light showing through the back of the slide and it does give you a little bit different appearance, I think. If you will compare the photographs to the slides you will see a discrepancy there.

Mr. Barber: One thing that Mr. Hoffman mentioned this morning was that he kind of messed up the schedule which he was trying to make these grades with these types of materials used as top liner. I assume you would ordinarily use waste materials and mixtures in your furnishes?

Mr. Hoffman: Very definitely! We used a single pulp, as we did here—we did this with the express purpose of trying to show formation.

Bill Lunceford (Consolidated Paper, Monroe): Were those trials all conducted in the presence of alum?

Mr. Hoffman: Yes. We did use alum during all these trials. As I said, they were produced from the production grade, but they did have alum. That's one thing we couldn't eliminate completely.

Mr. Lunceford: Would you expect that the differences would narrow up if you removed alum?

Mr. Hoffman: That's a good question, and I wish I could answer it. I think, given more time, we can run some tests without alum, but we didn't have the time to do that at the time we were running the tests.

Mr. Rice (Continental): Was the second machine essentially the same?

Mr. Hoffman: Almost exactly. It was a slightly wider machine.

Mr. Rice: Do you recall any freeness figures on these nine furnishes?

Mr. Hoffman: We took freenesses, but I don't have them with me.

Mr. Rice: I mean, among the nine furnishes?

Mr. Hoffman: No. We didn't maintain comparable freeness on all the furnishes. It wasn't practical.

Chairman Renegar: Mr. Hoffman, I've had a question handed to me. You stated that insofar as possible all furnishes discussed were given an optimum refining. Since tab cards and hard whites showed the best formation, and they had been twice refined, can it not be concluded that heavy refining of the softwood krafts would have definitely improved the formation?

Mr. Hoffman: Undoubtedly, if you give softwood kraft enough treatment, you are going to improve formation. I don't think there's any doubt about it. However, as I tried so say here, you can go only so far when you are using it on production board. You don't dare treat it too far, which is the reason why we could not give them the same basic freeness.

Chairman Renegar: I also had another question handed me. All the photos showed distinct formation differences. Are these differences actually small in terms of quantity and saleability of the finished board?

Mr. Hoffman: I think undoubtedly the differences are fairly small in the finished board, because all the board that was produced from these furnishes was of saleable quality. There was no rough quality board produced. If there were very large differences in formation, you wouldn't be able to sell the board.

However, this method does emphasize the differences. It does enlarge differences, and I believe you can say that the differences in the slides seemed much greater than they would have in finished board.

Chairman Renegar: I have another question that was handed me. In the photos shown, is each fiber being discussed present in the furnishes in the same percentages?

Mr. Hoffman: Well, perhaps I didn't understand that question, but in each of these furnishes they were all 100% of the furnish that I gave you. That is, a single stock was used in each furnish.

Allan Schenck (Riegel Paper): I would like to know the consistency with which these were run, and what are your thoughts about the effect of consistency upon the formation you were studying?

Mr. Hoffman: The consistency on all of these was approximately 0.4%, that is, somewhere close to that. Undoubtedly consistency is going to have an effect upon formation, as it again will affect the weight of the water that is

taken out and the amount of water you take out on the cylinder.

FRANK VOLKS (Champion, Carolina): I would like to have your opinions on vat temperatures on the formation.

MR. HOFFMAN: Again, these stocks were all run at approximately the same temperature. We did not make any trials with an increase in the temperature. These were fairly cold stocks when they went on the machine, and I'm afraid I can't give you an estimate as to what increase in the temperature would do to it at the present time.

MR. VOLKS: I would like to direct that question, then, to the panel, on the effect of temperature on the formation.

CHAIRMAN RENEGAR: Would any one of the panel members care to answer that question?

E. G. MANOGUE: I'd say definitely the colder the water the better the formation, at least from what we have seen.

Again, we haven't measured it except visually, but I was going to bring that in in speaking of George's refining, that the temperature, particularly of people who live in this part of the country where the water is very cold on start-up, we run cold water all the time, except for the drying factor, because we get much better formation. I thought it was generally conceded that you do get better formation with cold water.

S. W. YATES: I'd like to ask a question. Why do you think that is so?

MR. MANOGUE: Well, there is much other than the cold water. In the first place, maybe if you had warm fresh water —well, it wouldn't be as good, but as you run—we're running all return water, once we get running, and we have always found—and again, I happen to be making 9-pt., so I happened to get out of the liner field; but we normally ran it cold, and with fresh water. My opinion would be that you are going to gather a lot of starches and glaze and solids in the water that you can't foresee, and yet if you are going to measure your freeness with the white water in the stock as against cold fresh water, you'll see the difference right away, if you run cold water and dump it.

MR. YATES: If you measured the freeness at the two temperatures at which you are running, what would you get?

MR. MANOGUE: The slowest stock with the return water, as against the cold fresh water.

MR. NUTTER (Gair, Continental Can): Many years ago Harold Hill brought up this question of flocking, and he came down with the statement that flocking increases with consistency, temperature, and freeness, if that's any help.

MR. YATES: I think that's probably true.

MR. NUTTER: The tendency to floc increases with temperature, consistency, and freeness.

MR. HADLEY: Well, anybody that's ever run a lot of kraft—natural kraft—knows that temperature will kill you on formation, if you let it get too high. That's all there is to it. It's always been generally conceded that the freeness goes up, the hotter you get, and naturally with the freeness going up your formation is going down.

Cylinder board machines running solid krafts with a lot of virgin kraft in it, you will find generally that for the want of a better term—and the Lord knows that this industry has a language all its own, the terms of which are generally very descriptive—but when vats start to snot—which is very descriptive—cold water on the shower will immediately help you. There's no question about it.

And so apparently the freeness drops, and you start to form. The running of krafts anything like rope or kraft, or anything of that kind, generally I agree with Mr. Manogue, that when you start up on stock prepared ahead of time, that's had a chance to cool, you are going to run better as far as running is concerned than you are when you finally catch up with yourself and your stock starts to get hotter.

MR. RICE: Is that opposed to the temperature in the beater room?

HARRY E. HADLEY: I don't know exactly what you mean.

MR. RICE: Well, in other words, beating at one temperature, you get a different result?

MR. HADLEY: Well, this is a personal opinion, but I never like to beat too hot. We don't want to drag on here too long, but just take ordinary box cuttings from a carton plant, which the Lord only knows what's in them, because they may be various calipers of krafts and everything, and if you will run those hot, you will raise the freeness on box cuttings, and I know of some mills who save themselves a nickel here and a nickel there by freeing up back linings merely with temperature, in the place of using kraft to free it up. They just raise the temperature, and they get it free enough; so that you are back again to the question of the ability of the stock to drain water. That's the only way you can make it give up its water.

MR. SCHENCK: I can't answer this gentleman's question, but we put well water on two machines—this is on the machine water, and not on the refining; and in the summertime we improved the formation, but it's still not as good as in the winter, which certainly suggests that there are two facets to this. One is in the forming area, and the other is in the beating area.

CHAIRMAN RENEGAR: Well, I think we can clear up this question of temperature of the stock by saying that it's a pretty well established fact that control of temperature of your water, particularly when handling virgin kraft fibers or tab cards, high temperatures are definitely detrimental to good formation and good machine performance.

MR. HOFFMAN: Incidentally, on these trials that we ran, we used fresh water on all of the trials. They all had fresh water. We used no white water.

MR. VENALSON (Flintkote): Was it possible to correlate these different types of formations with printability or general over-all printing characteristics?

MR. HOFFMAN: I believe that it would be on the particular furnishes that we used, the particular boards that were produced. Naturally, they actually did not print the same, and that covers quite a range of board all the way from bleached to kraftboard. I think you can definitely bring printability into it, if you can take the study a little further.

MR. VENALSON : You didn't do that?

MR. HOFFMAN: We did not do it, no.

CHAIRMAN RENEGAR: I wish to thank Mr. Hoffman for a very excellent paper, and Mr. Barber for a very excellent review. Mr. Manogue will review Mr. Nicholson's paper on stock formation. Mr. Manogue!

MR. MANOGUE: It's lucky I'm about the second one, because I can see as it gets down the table, the last guy is going to have a hard row to hoe.

George's paper is on good formation, and again, coming back to that, the point is that the paper is made in the beaters, and I believe that very much.

George spoke of the refiners in the jordan and the general refining and the partial refining, which, I would say, would be jordaning in most instances. Probably the biggest problem among all of us is the fact that the measurement of these at the present time seems rather nebulous. I feel that if you can possibly measure refining and jordan after it—though, again, as George pointed out each system is for a special set of conditions, and to measure your refining and then touch it off with the jordan, that probably adds a lot to it, to get the right refining.

I was also going to bring up the effect of temperature both on the refining and on the machine, but it seems to have been gone over.

Also, the fact that pH has a great effect on refining. Not too much is said about it, and I don't know how much of a study has been made, but the people who run at a high pH level with a much slower stock, and presumably, slower drainage without being slower itself. Certain of the additives bring that out.

Again, people making boxboard liners want opaque formation, but people making a lightweight paper are looking for a translucent formation. If we get translucent formation, we feel we are getting what we want.

So, again, it's a problem of getting each to his own in that respect. Again, the consistency of refining, which wasn't brought out too much—but to gain the consistency in refining depends upon what you are going to get both in the refiners and the jordans.

I think George covered it very well, and there's not much that I can add, because in jordaning and refining it's almost every man for himself.

CHAIRMAN RENEGAR: Thank you, Ed. I wonder if you have any questions that you would like to pose to George.

MR. MANOGUE: No.

CHAIRMAN RENEGAR: Unfortunately nobody from the floor gave you any questions either. Is there anyone who would like to ask George some questions?

(No one responded.)

That being the case, Ed, it looks like you and George very capably answered all of our problems for us. Thanks very much.

Our next paper was machine design, which was presented by Mr. Milne, of Black-Clawson, and Sam Yates of Robertson Paper Box has agreed to review that paper, and I'm quite sure that in talking with Sam he has a lot of interesting things to bring to your attention.

(Charts were set up.)

MR. YATES: Gentlemen, I do not like to speak without charts. One look saves a thousand words, they say.

I think the ground was well covered by Mr. Milne, and basically, I do not have any great criticisms of what he had to say, so in order to be constructive I will try to supplement it somewhat from experience.

Now, anything I have to say of necessity has to cover equipment and gadgets and systems, rather than operations. Harry Hadley is the operations man today. Incidentally, on the side, that's the fourth time I have heard the man, and each time he gets funnier. (Laughter) I hope that's a characteristic of age. How old are you, Harry?

MR. HADLEY: Too old! (Laughter)

MR. YATES: If I were Mr. Hadley's sales department, instead of saying the board is so good, it forms and bends, etc., I'd call it "humorous board," because Harry Hadley seems to built humor into it. And I'd like to say that I have used some of that humorous board, and it didn't hurt a bit.

Now, the nature of what I have to say is not going to be very profound. There are many men here who have had more experience and I see men at whose feet I say and learned. I see Sam Hodge out there, as well as Henry Abernathy, Harry Hadley, and others.

Well, much of what we learned is at somebody else's feet, and nobody knows it all. My own experience has been about half paper and half cartons, with a little bargaining thrown in to make it interesting. The first 10 years were in paper, and in a way it's like the first love. However, box making is also extremely interesting. In fact, I think the whole industry is very fascinating, very broad, with a great many professions and skills in it, and you never stop learning. Any man who doesn't learn as much per day at the age of sixty as at the age of forty isn't working very hard.

*Knowing the What as Well as the How.* Now, one great problem of the board maker, I think—can be trying to satisfy the management in a box factory or converting plant when they don't know anything about the board business.

I have witnessed a situation once where the sheet was offsetting very badly, in the box factory, and the poor old board man, they had him down on the floor, really walking on him.

You see, they were using a weak ink, and about 65% too much volume on. Of course, the thing couldn't help but offset. There's an old statement that 10% too much ink on a printed job on boxboard will give you 100% more problems, and it's just about true.

Now, by the same situation, a board maker who knows and has had experience in box making, and with customers can really know what is needed and often obtain better board—not *per se*, but to do the job. If you tell any board maker what the customer really needs, most board makers in the country can do it. The big job is to find out *what* is really needed to do that job.

I had an experience once wherein our boxes were the only ones that would work. We were asked to give our board specifications. Well, we did give them a set of specifications. Is there anybody here who doesn't know what happened? (Laughter)

If you can see into the customer's plant and know the machines and know exactly what the carton must do, it's usually easy to do it, and the board makers in this country generally do not get this chance, and they are guessing, and they get specifications which do not solve the problems.

And so, if I had to say three things about what to do, it would be: study what each job really needs, and tailor the product to do the job. Secondly, put guts into the board to suit the job, so that you get machineability, stability, and firmness in your carton. And third, I would make it bend, speaking from a box factory point of view.

*Formation.* Contrary to others, I accept that formation is the formation of the finished sheet in the cutter box. There was a study made some years back. They followed the characteristics of the sheet from the cylinder molds right to the cutter box, and made tests of the formation and other tests at various points through the machine.

A felt can destroy an orientation, or it may also help it. You might say that the formation log in the conventional vat and machine is, first, to give you a fairly good formed orientation in the first quarter of the mold; that is, while it's in contact with the solution. Then it proceeds to disrupt the orientation, which we all know—that is, in the conventional vat—and then through the balance of the machine a modification takes place and basically I think the modification is really an improvement.

*Basic Need—A Vat.* Now, what does the industry really need? In spite of what I'm saying, the big job is really right at the vat. We can buy everything else to accomplish the purposes on a cylinder machine—except purchase the kind of vat you want. Calenders are easy, cutters are easy, driers, press rolls—you can buy all the refiners in the world you need. The thing you can't buy is the kind of a vat that you really want.

There's nothing wrong with the cylinder board machine that a good vat that we are looking for wouldn't cure.

Are we going to get one? Well, you know as much as I do, but I advocate optimism.

*Slushing and Defibering.* The formula is operations. I can't talk about that, but fiber slushing, separation, and mixing is basically machines.

Now, one of the big needs today is a more perfect breaker-upper. Sure, we have pulpers; we have many of them. A good friend of ours put one in not long ago, and said, "Say, we have the real thing! Come and look at it." So our superintendent did that. He took some stock and made handsheets on it. We hate to tell them how bad it is.

So before I came here today we took handsheets on our liners ready to go to the refiners. There's a top liner, a filler and a back, and, sight unseen, here's the way they are, and I'd like to pass them around. Look through them toward the light.

They aren't very good, gentlemen. There are pieces of unbroken stock in the top liner. The filler isn't too bad, and there's a lot of unbroken stock in the back liner.

Now, we have conventional equipment, and we give it the works. We control pH all the way. Our order of furnishing is right according to the book. The only thing we do not

break is the stock, as it should be, and it goes to the refiners in that condition. Our plant engineer, Mr. Williams, has been pointing this out for some time.

Now, I submit to you that the specks of stock that you are going to see affect formation. Those little blotches, by the time they get to the vat, have very little treatment. I think you are going to see development along this line, and I'd like to ask Mr. Milne when I get through here what the future prospects are, as far as pulpers are concerned.

What is raw stock? Raw stock without treatment I liken to hay or to a bird's nest. If you make paper from raw stock, it would be like hay in a barn, or it would be like a bird's nest, sticks and stickum.

Why? Well, your fiber in a spruce tree is about $^3/_{32}$ in. long, and in hardwood it's about half that. Like little soda straws, they are harsh and they must be treated to make a sheet.

We have to get quality, production, folding, finish, uniformity, and printability. Now, which method will we use?

*Nature of Treatment.* Some years ago there were large-scale tests made on the same furnish. There were about 15 tons used in each test from the same furnish, and the same sheet made from different methods of treatment. One method was the high-speed Hollander beater, and the second one was refiners and jordans. They were five in all but I will only mention those two.

Now, tests must be made correctly and maybe they didn't make them right, but here's the results. The Hollander beater give 15% better color and strength than refiners and jordans. Well, maybe the beaters were slow to beat up, but there's just a piece of information to keep in mind.

I called on a former president of the Paper Mill Superintendents Association, and went through their plant. As I came in, he had a problem on his desk, just like you men do. On his left side he had a request from the sales, and customer, and on the right-hand side he had a quotation on additional refinishing equipment which would curl your hair. He looked at the problem and said, "Gosh, when is somebody going to invent a coffee grinder that will do this job for about $5000 or $10,000?"

Certainly there is a need to find a way of treating stock without all this money. Maybe it cannot be done, but who knows?

*Freeness.* There is still some misunderstanding on the meaning of freeness. To me it is one fact, just like blood pressure or sedimentation rate, etc. Many still think it is a full measure of treatment rather than a drainage rate. You bring a bucket of stock and say that the freeness is *X*. We can mix up a bucket of sand which will have the same freeness. It's always possible to make up a mixture of sand which will have the same freeness as stock. How would you like to try to run the sand on the machine?

It is only a factor and much depends on how you get it as I have heard Mr. Hadley say in his talks.

*Stock Treatment.* First, mention was made this morning about drastic as well as moderate treatment. In general, my own experience is that your system and your equipment should be as gentle as possible with the fibers, and only as harsh as necessary. We buy long and expensive fibers, and we spend money to treat it, and if we end up cutting it all up instead of brushing it up, it seems like two wrongs to do one right.

I was in Europe last May—in every country I went to they always told me a story about the country I'd just been in. When I got to England, the Englishman said, "You know, I have trouble understanding Americans." "They seem to always do things backwards. Take making tea. First they make it hot, then they put ice in to cool it; then sugar to sweeten it, and lemon to sour it. I can't understand them."

Well, I think of that when you buy good expensive stock, and then you turn around and cut it all up.

What is the process of hydration? This is what it's supposed to be. You pound any air out of the center, flatten and rub fibers, fibrilize the ends and sides, and there is some kind of hydration and some shortening of the fiber.

Now, what are the other recommendations? Second, I think every piece of equipment will do a better job if you will back-cycle that particular piece of equipment, whether it's jordan or a refiner. In other words, it's better to go through a jordan twice being a little more gentle on the stock than it is to go through it once when you are very rough. We have done that in every one of our units, and we find we gained a great deal from it. You get a better blend of stock and a better folding etc., and that is important.

The third recommendation: control the refiner flow at the outlet. This isn't really operations, because you have got to set this equipment up to do it. Control the flow at the outlet and use low-pressure flooded inlet. In other words, your refiner is always flooded, and you are controlling uniformity of the flow at the outlet, and we recommend a squeeze valve on it with an indicator showing how wide it is open.

One reason for that is that your beater man will keep flows even, whereas if you try to control it from the inlet, it's too far up there so he will change it once and let it run; but if you have an indicator valve on the main floor, and anybody can come along and see it, and you tell him you want to keep everything even, then he's most likely to do it. This system eliminates surging also.

We consider those three things very important on this question of getting uniform treatment. We have all said that paper is made in the beater room, and that's what we are talking about. Your formation is made there too, to a large extent.

*Consistency Regulators.* I was in a plant—and they were using a consistency regulator right ahead of the refiners, and they said, "Well, we have good consistency here. Take it in the chest and it runs around 3.5%." But what was taking place? The stock was varying from 2 to 4% by actual test, and it was averaging out to 3.5%, all right. So at 2% you know what was happening, and at 4% you know what was happening, so as a result of that you had a mixture of good stock and bad stock, and what do you get when you have that mixture? You know.

Well, these things are real, and they can happen, and if you don't watch out they will happen to you.

Of course, you can have the correction made back at the previous chest if you wish. Another thing you can do is to start with a measured consistency in the pulper and not rely on all these gadgets. Get it in there right in the first place.

Another little point: it's good to make tests about every 10 or 15 sec. and plot curves to see what's going on from second to second. You must think of uniform consistency, and not average consistency. That's really important.

*Screens, Piping, Mix Boxes.* We have found in our experience that the white water flow back to the screens will often surge. You can have a syphon action, and you will get a rush of water on your screens, and then it will hold back and you will find the surging follows right down to your vats. You will have to let some air in to stop the syphon.

We found that mechanical scrapers caused surging in the vats, and so we took them off. If you want to get uniformity, you have to get uniform levels down in the vats.

This is probably contrary to accepted practice, but necessity is the mother of invention, and any port in a storm. We run a level high in our mixing boxes. We do not allow Niagara Falls to take place between the screens and the mixing box. We keep the mixing box agitated, and then we run a control valve between the mixing box and the vat, with push-button control on that valve out in front of the machine. The man in front of the machine, in watching his vats, controls the head at that point. You can cut out the surging, and in the study of hydraulics water does not rest. If it surges one way, it will surge back, and this goes on and on.

With push-button controls out in the front—your machine tender, or whoever is handling it, has a much better chance of watching and controlling his vat.

One more thing. Have as much white water go back to your screens as possible, and that helps your flocculation and many other things.

*Cleaners.* Centri-Cleaners—nobody mentioned those, but, you know, if you don't have them you can get a lot of sand in your vats, and it will really affect the formation.

Another thing—metal lining of your vats. This is equipment, so I bring it up.

*Edges.* Edges—that also involves equipment. Personally, we do not like conventional wings. We found they disturb the formation. You need a smooth surface over the top of your board, so I would suggest one. If you want to have a wing, put a U-shaped metal, sharp corners, over the top of the making board, so that the whole board moves, hinged at the center or near the side rather than just a sharp piece of metal at the back edge.

*Vat designs.* Well, there is counterflow, which is conventional. There is uniflow, which is conventional, and there is a combination of cylinder and fourdrinier as used in Europe; amazing to see them—a top liner coming down from upstairs, from a fourdrinier, and joining itself to a cylinder sheet by a perforated brass pressure roll.

There is the Rotoformer and the Semi-Rotoformer, and the Stevens vat, and the Interform, which is English.

*Consistency.* Consistency in vats is misunderstood. You often hear people say, "Look. Why don't you run your consistency down and be done with it?"

Well, there's not an awful lot you can do about consistency. One man said to me, "Why don't you do what you have to do? Slow down." And I said, "That would be all right, but we'd have to take ourselves off the payroll in about three months."

Now, what about the cylinder machine? I think the cylinder machine is a very outstanding piece of equipment; and as soon as we develop the right vat, we'll really have something.

*Miscellaneous.* Going on to drum roll primaries and main presses: the packing in the first two presses that you hit is very important to make your sheet so that it will take what it has to stand later. Second, we believe in rotary slices on primaries.

*Wire Mark Disturbance.* Well, you can use finer wire, you can come off the driers at a proper moisture, but one important thing is getting your stock treated right. If you do not, why, you will take marks out at the calendars, and they will come back later.

*Future.* Now, what about the future? I think it was St. Paul who said that Faith is based on hope and evidence—and I would resolve those in a practical way. In place of hope I would say "assumption," and in place of evidence I would put "experience."

So, as I see it today, I assume that we will develop a formation device which the cylinder board industry is looking for, and at this moment I see evidence of it and experience with it.

I would now like to ask Mr. Milne three questions: what are the prospects of better pulpers in the future? What do you think the vat of the future will be? And what do you think the future methods of refining will be?

Thank you very much. I enjoyed it. (Applause)

W. S. Milne: Those three questions cover a great deal of ground, I'm sure. Taking them in the order that they were given, as far as pulpers are concerned, I think, Mr. Yates, that we have some of our representatives here that would be happy to discuss some recent developments that they have made in refining-type rotors. It's a different type rotor which shows some promise.

I'm sure that beyond that there will be additional pulper developments as the entire industry progresses.

On vats—this is a pretty large order also. I am sure that you are all familiar with the work that is being done by all the builders and the designs being developed for new vats. I think that it's going to be some time before we are completely sold on one basic design that's going to be 100% successful for a general cylinder operation.

Chairman Renegar: Are there any questions from the floor on Mr. Milne's paper? (There were none.)

I had one question here handed me right before lunch. What vat circle measurements are you currently building for direct flow vats on top liner cylinders for speeds of approximately 200 to 400 f.p.m.

Mr. Milne: I think it's pretty common; six, five, and four are relatively common. They have been closed in beyond that, but I think that's probably a representative figure.

Chairman Renegar: It's a direct flow vat that he is speaking of, Tom.

Mr. Milne: Six on the inlet.

Chairman Renegar: Another question was handed to me. What is considered best on uniflow vats, the use of holely roll or the rectifier roll, and what is the difference?

Mr. Milne: The difference is just one of terminology, as far as I know.

Chairman Renegar: That's what I thought.

Mr. Milne: As I attempted to express this morning, we probably are getting into conditions where rectifier rolls or holely rolls will probably be applied more frequently. The thing that has held them back more than anything else is probably just a matter of cost.

Chairman Renegar: Does anyone have any questions that he would like to ask Mr. Milne or Mr. Yates? I think Sam did a very good job of presenting a lot of problems which exist in our industry. (There were no questions.)

If not, I wish to thank you, Mr. Milne, and Mr. Yates, and we will move on to the next paper, which will be reviewed by Mr. Coffman, of Chesapeake Paperboard, on a paper which Mr. Hadley presented this morning on machine operation.

I would like all you gentlemen to realize that Mr. Coffman is operating under extreme difficulties, because, in keeping with his customary procedures, Harry threw the text away and preached absolutely from the cuff this morning. (Laughter)

Mr. Coffman: I was going to say that after Harry wrote this paper he either threw his away or sent me the wrong one. I don't know which. (Laughter) I don't have his paper, but I have got one here.

As Harry so ably put it, formation means all things to all people. It is a very wide description. When you talked of formation in some of these talks here today, you would say "poor," "good," "acceptable," "excellent." Well, you have to draw the line somewhere.

But Harry's main thought was to try to educate the personnel on the machine, and that's most important, as far as I'm concerned, because I ran a machine for a couple of years, and I did just what he said. I put suction on. I didn't circulate more water, but I put suction on the vat, and it took me quite a long time to know what I was doing, because I had not been properly informed.

In machine operation to get good formation you are using large amounts of water. It's the only means of transportation that the fibers have all the way from the pulpers or beaters, all the way through the machine. So it's just like a system of railroads or any other means of transportation. It has to be handled right, if you are going to be successful with it.

He mentioned the fact that the water is being metered into the mill and out as well. We have the same problem. They do allow you to evaporate a little bit, but they watch that awfully close. (Laughter) So the methods that we use in transporting fibers could be improved on, I'm sure.

I heard Sam here make a remark about how they are trying to control levels in their mix box in relation to their vats—surges—water levels. That's what you are dealing with

when you are getting these fibers to the machine, and when they form, the only control that you have over it at all is the differential in level on the outside and the inside of the mold, and if you have dirty molds, why, of course that's going to resist water, so it's going to run over to the edge or the middle, and it's going to form heavier there, which is going to be malformation. You can't rush the fibers to the vats and expect them to lay up and give you formation. You have to keep them fairly constant.

The effect of dirty cylinders and felts—they have a direct bearing on good formation. I don't know. When you put a new felt on, you have one rate of water removal. You run that felt for a week, and that felt changes. He spoke of these people that weir the water from their presses. That is possible, and I can see how they could do it, but that's bound to change. I don't see how you can keep it constant; but, of course, you can't afford to take the felt off before it's half worn out.

But what is the optimum? Do you run it until the thing is causing you so much trouble that you have to take it off, or do you decide that, well, 10 days—that's the average, so when we get 10 days on this felt, I'm going to take it off?

And again, he mentioned the blows in the sheet. Sure, that doesn't come in instantly. That gradually builds up to the point where it is going to cause you trouble, and that's where, if this person who is responsible, this machine tender or whoever is responsible, comes in—to be able to see or sense some change taking place there. He can help you out an awful lot. I think that's where we all fall down a little bit, in being forced into doing things that we don't like to do.

I known that when it comes time for a backtender to get promoted—because the Union is going to insist on that—he's going to get the job, because the Union is going to make sure that he does, but he's never going to learn what the machine tender's obligations are until he goes down there, and you are going to suffer with that for a while unless you can give him some pretraining or some kind of an educational program before he does accept that responsibility.

The machine help are limited in what they are able to do as far as controls are concerned. There again the machinery builder is doing everything that he has found being done in the industry, and tries to incorporate it into his equipment, but I think we have a lot to be desired as far as approaches, vat clearances, controls, wings, and overhangs are concerned.

But there again it's a necessary evil, because if you set it up to run 16-pt., and you are going to run 40-pt. on it, the amounts of water that you handle to the vats and the amounts of water that you are taking out of the sheet—again, it's going to vary, so you can't get set to handle all conditions ideally.

Chairman Renegar: Thank you, Cletus. Do you have any questions that you would like to ask Harry?

Mr. Coffman: Yes. I would like to ask Harry if there is any more or less standard procedure set up in your mill, for instance, for educating these people?

Mr. Hadley: We, of course, have no absolute standard procedure, because the procedures would have to vary as the individuals vary, of course, but we have tried various methods of training, paralleling, for instance, with the hope that some of the good factors of the machine tender will rub off on the back tender.

Now, where you have got to be careful in this is the fact that the average person has a certain amount of bad habits of his own that differ from everybody else's bad habits, and he will learn more quickly the bad habits of the fellow he is learning from, coupled with the ones he brings himself, and you can get yourself into a situation where you have to take curative measures.

The only trouble with paralleling is the fact that there isn't a definite responsibility with paralleling of people. That is the bad feature of it, that he is there, but the other fellow is there to hold his hand in case something goes wrong. However, I know of no other way to do it, unless you want to train these people on the job alone, and as Cletus so aptly states, you have to give them a trial period.

Here's where the trial period fails, as far as I'm concerned, and has always failed. It's because the top management—and I have done this myself—say, "Let him do it." You say, "By God, let's find out whether he can run this or not." But the tour foreman is responsible for processing, and he isn't going to stand there and let this guy just make hay all night to prove the fact that he can't run the machine, so at the end of 4 weeks the evaluation is, "Well, he hasn't done too poorly, so I think we better put him on."

Well, he hasn't done a thing. The other fellow has done it for him.

Now, it's a hard thing to train them. I think the thing, basically, is this. This is the thing that you will find in all machine crews, and I have heard this statement used, and it has been used in arguing with me. You will have certain machine tenders who are better production people than others. Everybody does. And when you question one of the other machine tenders in regard to his performance compared to the other fellow, the other fellow will say, "Well, no wonder. He has a better back tender than I have."

Well, the only reason is that he's a better machine tender. That's the only reason. People copy after people, and all good machine tenders have good back tenders eventually, because he sets the standard of performance.

So it's a question of training at the top, and it just follows. It isn't simple by any means, but all it takes is interest.

Let's just think for a minute of our own individuals. Who were your good teachers in school? Who were they? I'll tell you who they were. They were the ones that you liked. And why did you like them? Because you learned the most from them. And why did you learn the most from them? Because you wanted to please them. That's the reason. You tried harder.

Basically, it goes that way with training people. A good teacher can teach no one anything. All they can do is create a desire within them to learn, and they learn themselves.

Now, that is exactly what a good teacher does. A good training program is based on that. It's to create a desire and an atmosphere for them in which to learn, and they will do it. You are not going to drill it into them.

As I have often told foremen who worked for me, "Spend no time figuring out easier ways to do things. These fellows will give you cards in spades at that. They have already figured out the easy way to do it before you thought of it. But you figure out the best way to do it. If that turns out to be the easy way, you have no trouble. If it doesn't turn out to be the easy way, that's why we have you." It's just that simple. (Laughter)

I would like to answer one point that Cletus raised about water compressors. Well, to use just a figure—and I'm not sure of this, but this particular machine that I'm talking about produces what I consider to be a phenomenal tonnage. It's 196-in. trim. It's a fourdrinier, and they run 16-pt., and their tonnage runs between 800 and 900 tons a day. That's not to be sneered at by anybody in this room. They wind a 60-in. reel every 7.5 min.

Now, I don't know what the winder crew does between reels. (Laughter) Anyhow, they do have a little spare time.

So, inasmuch as the machine is built for production of one grade, then everything has to geared for production, and they measure the water from the presses, and they set a figure—I don't know what it is. We'll say just for the sake of discussion it's 100 gal. a min.

Now, when they put the new filter on, maybe it runs 150 or 200 gal. a min. of water extracted. That's all just a figure dreamt up now. But when it hits 100 gal. a min., that's where the felts come off, because production starts to suffer at that point, and nothing can be allowed to do that. Their

drying rate goes up, and such things as that, so when it hits a certain figure off come the felts.

Now, they don't shut down and change one at a time. They shut down and change all three of them, and if they have damage to a felt, they will change all three of them rather than face another shutdown. But that's how they tell. There is some place where they break it off.

CHAIRMAN RENEGAR: Sam, do you have a question?

MR. YATES: Yes. I'd like to ask Harry Hadley if he thinks on-the-job training can be supplemented with short practical group meetings, with probably one or two or three employees as they go along, getting at the idea of explaining to them what they are trying to do and how things are.

MR. HADLEY: If I could have a moment, I'd like to tell you a personal experience I had. I know what Sam was leading to there. He threw me that one from way out in left field.

A number of years ago at Gardner I decided—or I didn't decide; I happened to think of it in a sober moment—that maybe these fellows didn't know enough about what we were trying to do, and so, asking just simple questions of various people at just any opportune time, I found out that they didn't know what they were doing.

Now, our mills in Middletown, Ohio, and Lockland, Ohio, are like a lot of other cylinder board mills. They are not integrated mills, and the pulp is purchased on the outside, and there are people who have put in thousands and thousands of tons of sulphates or sulphites into the beaters, and didn't have the foggiest notion where it came from, and if somebody was to ask them what it was, he would, with his tongue in his cheek, say, "Well, they tell me it's made out of a tree, and it doesn't look like any damn tree that I ever saw, especially in Kentucky." (Laughter)

Now, if they don't known that, how can they have interest in what they are doing? I talked to machine tenders and asked them if they knew anything about the design and structure of paper mill felts, hundreds of which they had put on the machine, wet in, and run, and had various degrees of success with. They didn't have the foggiest notion of how they were made, or, really, what purpose they served. They knew nothing about a lot of the things that we take for granted.

So, on the basis of that, through the Union—and you have to work everything through the Union; don't make a mistake there—I approached the Union president and asked him, and he, fortunately, happened to be a fellow who was very interested in promoting the welfare of everybody—a very good, conscientious man. I'm sincere in that. In all respects he was a good man, interested in both the company and in the employees, and when you find that, you have no fight.

And so he said he thought they would be interested in this, if it could be done.

Well, I knew it could be done, having been a frustrated school teacher myself. I knew it could be done. Finally I said to him they might have to do this on their own time, so we did this on that basis. We paid them for it, but we told them at the start that we wouldn't. We wanted to see what was going to happen.

And out of, I will say, approximately maybe 300 people—that's a guess; maybe 250 people who would be eligible that you would want to have participate in this, we had over 200 people participate in it for a period over 16 weeks. The sessions lasted an hour, and in order to take care of the rotating shifts there was one shift that had to have it twice in one week, because they skipped the next shift, and we would do it on Mondays and Fridays.

Now, we had facilities for it. We developed a tremendous interest in it. We trained them in every shape, way, and form. In very simple terms, we talked about heat transfer, and such things as that, when we talked about drying. We talked about the flow of water in pipes and friction in pipes. We talked about everything. We had diagrams drawn of pulping equipment, the insides of suction rolls in a very elementary way, so that it could be explained.

The benefits from this were terrific. The foremen went too, you see. The foremen didn't feel as if they ought to go at first, but at the end of about the second week the help started to ask them questions they couldn't answer, so they thought they better go too. (Laughter)

So it was a very successful arrangement, to the point that 2 years after that the Union came forward with a request that we repeat the thing again.

Now, a thing of that nature can be developed to a high degree. You can take these people and visit pulp mills and felt mills—they have never seen them. We have people running cylinder board machines in Ohio that have never seen a fourdrinier machine, and the Seward Paper Mill is right there in town, with seven of them. It's all available, but you would be surprised what interest you can get. People want to belong.

It is a wonderful experience. It is very rewarding to everybody who participates in it.

CHAIRMAN RENEGAR: Are there any further questions? On Mr. Hadley's paper this morning?

D. B. GEFFKEN (Sealright): You made the remark, of course, that the skid of paper and all that's in it will readily meet approval or rejection from the printer as soon as he looks at it. Do you think that you can make a better sheet of paper at higher speeds than at the lower speeds? In other words you have increased your speeds in the last 10 or 15 years, and assuming everything else is equal, are you making a better sheet formation-wise?

MR. HADLEY: I'll have to put it this way. In the 38 years I have been in this game I have seen a lot of changes. I have been against every damn one of them (laughter), and some of the things that have happened in the past 15 years I have been against too.

I will say this, that you are making sheets now that you know more about the requirements of than you knew 15 years ago. This has been a two-way street, I think, in most cases. Well, I'll have to put it this way. We're not in a peculiar position at Gardner any more than a lot of other people are in this room, but we are also printers, and we print pretty close to 500 tons a day, all told. And so, therefore, we get pretty close to the printing problems that are present, and we have found out, in the past 15 years, probably, more things that you can't do than we knew before, and we have, as machine speeds have increased—there's no question about it; your tonnage rates have increased, which I think basically is wrong in its concept, as far as cylinder machine operation is concerned—but we have also had to temper our thinking in regard to more tons, in regard to specifications required, because we know now what they are.

There have been a lot of things happen in the cylinder board field in production that have made it necessary for us to do lots of things in our cylinder machines that we thought before were not practical or even possible.

However, I will say this, and maybe this answers your question. I will say this, that it is harder today to make an acceptable sheet of paperboard than it was 15 years ago, ignoring the fact that 15 years ago there was a war on. I think it's more difficult to make a sheet of paperboard. Why? Think in terms of it for a moment.

Let's just pose the problems that you have. When we sit down right north of Cincinnati, and we are within overnight trucking distance of Milwaukee, Wis., and, of course, Chicago and St. Louis, and almost Buffalo—we can get to Buffalo in 16 hr. Now, all people are alike, some more so than others, but they are almost all alike, and they like to operate on your money. I would too. So it used to be 15 years ago—or even longer than that—when people ordered 50,000 lb. of board from you, they ordered it at least 30 days prior to need for it, because of the fact of rail shipments being

delayed, and you had to get it there, so you got to their plant possibly 2 weeks or 10 days at the least before he ever went to press with it. That gives you a chance to turn around if there is anything wrong.

But now he has put in a scheduling department, the same as you have—darn him!—and he has also put in a quality control department, the same as you have, only more so, and what happens?

Do you get orders that tell you the time of day to deliver? We do. He doesn't say, "I want it a week from next Thursday." He says, "I want it at half-past nine a week from next Thursday," and he expects you to have it there. He has his makeready, and if everything has gone well, he has scheduled it right down to a gnat's heel. He has delivery problems to meet, but he wants to get his bill out to his customer before he pays you, and regardless of whether that's even a factor, the fact remains that it comes in the door, and he puts it on the press.

Now, if anything is wrong—that's the reason why we're known as the Gardner Board and Aeronautical Corp. (Laughter) They keep the motors warm all the time for me. So it has become more difficult to produce a sheet of board today than it was before.

Now, there are other factors in it too. There are some cheaters in this business. I don't know whether you know it or not, but there are a few cheaters, and so sometimes you get a sheet of 20-pt. ordered—to use this example—and maybe that rascal cut a point or two off from his caliper on you, in order to get mileage, and if anything happens on his customer's machines about stiffeners or anything else, you will have trouble. If you run it a little on the light side, which you are prone to do, and which the industry says is acceptable, you can be in dire straits.

So it is more difficult. The work produced on the presses is more demanding. The speeds of the filling machines have increased sometimes 300% in their customer's plants or your carton customer's plants. All of those things have happened; and also he has got very conscious of ink mileage, and all of those things.

Now, there's another factor in it, and I don't want to get into the economics of it, but you know customers sharpen their pencil when they bid on jobs, and if anything goes wrong with his production, he can run in the red quickly, because he has no cushion either.

So I will say that, that it is more difficult, because the demands of the industry have increased. Mainly that's the reason for it; and also, they got smarter.

Chairman Renegar: Well, Harry, I'd like to thank you and Mr. Coffman for a very excellent presentation and review of your paper. At this time I would like to ask you and Cletus please to step down, so that we can get the other gentlemen up to the table. Mr. Weidner of Container Corp., will review Tom Brookover's paper on the predictability and measurability of formation of paper.

J. P. Weidner: I think the big point that Tom has made by very careful laboratory techniques and, should I say conclusive opinions from various people—because I don't believe any two people can agree on what is good formation by just looking at something or taking a picture of it—he has come to the conclusion that because there is this wide variation in formation characteristics that an absolutely critical method of determining formation characteristics is not really of the utmost importance, as long as he could be satisfied that it would be somewhere between awful and perfect, with the emphasis on the fact that he would like to be assured of uniformity.

If I could move away from the paper just a little bit, I'd like to say that any way of attaining this without resorting to mechanical means, I believe, is doomed to failure, because of the wide range of calipers and furnishes that it is necessary to run on most cylinder machines. It would be impossible by changes in the machine, changes in the refining, or any other thing that I can think of to arrive at this type of formation without a mechanical means which will be the great leveler.

I don't know how you can make progress in this regard. I am convinced that it will have to come.

If you go back to the fundamental characteristics of board, you have to be able to print it successfully. I think that by the use of a proof press or some other printing device it is possible at the present time to find out whether you are in the middle of the road or whether you are awful or beyond hope, as far as printability is concerned. Again, I don't know if that is precise enough, because the amount of ink and the types of inks vary with the various printing processes.

There is, perhaps, much that can be done by blending furnishes to get the best results with the equipment that is available now. These are just opinions, and I hope someone gets up and disagrees with them violently.

Chairman Renegar: Thank you, John. I think that is a very excellent review of a rather, shall we say, nebulous subject, and it's the subject of formation and how we actually measure it that we are all looking for, but we don't actually know how to do it.

Do we have any questions from the floor, or do you have any questions that you would like to ask Tom?

Mr. Weidner: The only question that I would like to have Tom's opinion on is how right now you would measure at the end of a machine whether a board will be suitable for any given printing process.

T. S. Brookover: John, I think I answered the question the same way you would. The only way I know to measure it dependably is by subjecting it to a converting process, such as it will have to be subjected to in the customer's plant. If printing is the thing that will govern, then you would have to test the sheet, in my opinion.

We have all had cases—I shouldn't say that. I think we probably have all had cases where one customer may have had trouble with an order in printing, for instance, and when this board taken from the machine at the same time is sent to another customer, it has proved satisfactory on the same type of equipment. It depends on what the print job is and how it's handled in the printing shop.

I know of no simple means of testing. I think Sam covered that too. You have to know what it's to be used for and how it's to be used.

I think it was Harry Hadley this morning who made a case for uniformity, and I think that it is the simplest and best answer to the whole problem. The trouble is, we don't know how to attain it.

Chairman Renegar: Lew Ayers, do you have any ideas on this subject of how to measure formation?

Lew Ayers (Gair Co.): Well, it's a problem that we all have, that has been kicked around from so many angles that it's hard to add anything new, but this morning—I forget which of the speakers said it—an important point was made; namely, the customer's initial reaction.

Now, there are a lot of phases more important, but I am sure we have all seen formations with show-through, and immediately the initial reaction is, "We are going to have trouble before we even try it." From a practical angle formation is the first thing a person sees when he looks at the sheet. There's a psychological factor there alone; and, of course, as John said, if you are looking at formation in terms of printability, how it prints is the final answer. The only thing is that it is a rather awkward control test as the machine is set up. When you are printing at the end of the machine, you are probably using a letter-press process to test it, regardless of the final printing process.

I certainly agree with the idea, though, that we have to get the subjective opinions out of this question of formation, if we are going to get rid of a lot of the guesswork. You may move the argument up or over to determine what the significance of this test is, and how it correlates with the end use,

but at least from the moment of making the test and rendering judgment, you can greatly simplify it.

JIM HARRISON (American Carton): Do you have any ideas of how we can measure formation?

MR. BROOKOVER: I'm afraid not. It's been pretty well covered.

CHAIRMAN RENEGAR: Then I imagine that you have pretty well corrected all your problems as far as good formation is concerned. (Laughter) Maybe that's taking a little unfair advantage of you.

MR. BROOKHOVER: We have corrected one or two.

CHAIRMAN RENEGAR: Does anyone else have any questions?

HANK KLAUKE (Container Corp.): I wonder if someone would like to comment on the subject of filler and the various types of filler materials in conjunction with formation over and above the opacity that you might get from it—calcined clay versus diatomaceous, or regular clay, or what have you.

CHAIRMAN RENEGAR: John, would you care to voice an opinion?

MR. WEIDNER: Well, it would be an opinion, but it's all right. Actually, your selection there will be based on what you really want. If you want hiding power, I believe that's one thing. If that's the important thing, then that's that. If you want hiding power after waxing, then that's another problem, and that would be another type of pigment. If you want pigment to help close up the sheet, and you don't care about other characteristics, then I would probably say a beater clay, which is cheap and will help the formation, is the best thing.

Diatomaceous earths and calcined clays and things like that are apt to give you a very severe abrasion problem and wear out your equipment.

I don't know. Tom, do you have anything to add?

MR. BROOKOVER: I don't think that mineral fillers as such will actually improve formation. They may change appearance. If they do affect formation, I think that it is another example of one of many variables which in themselves can affect a given set of conditions, but controlling just one of the variables won't solve the problem. I believe they all have to be controlled, whatever they are.

We have heard many things today that would affect formation, but not any one of them will guarantee it.

I'd like to add this, that on that experimental machine that we worked with at one time we put very lightly refined sulphite at the same speed and the same weight as we did ordinary filler furnish, in ranges of 400 to 500 f.p.m., and the two types of stock looked about the same. Unfortunately, each of them formed a clotted looking sheet, but we blamed that on running something like 500 g.p.m. stock supply through an 18-in. pipe. We understood that this device would require great volumes of water, and we found it wasn't so. Consequently, the flow was cut down, and we just had too big a pipe for the amount of stock flowing through it. The flow rate was slow, and therefore flocculation took place, but the long fibered free stock looked just about the same as the short fibered filler stock.

CHAIRMAN RENEGAR: Do we have any more comments from the audience? (No one responded.) Well, I think this has been a very interesting and highly informative symposium on formation. We have not attempted to solve any of your problems. I don't think that you can do that in this type of a session. The only thing that we can do is to stimulate your thinking about the problems which you have in your respective mills with the hope in mind that we do stimulate your thoughts sufficiently so that you can possibly go back to your own mills and work on your own problems from a different viewpoint, than what you previously had.

We're all striving for this perfect formation. I think that sometimes, as far as perfect formation is concerned, as has been stated here many times today, that it's more a question of the customer's first eye-appeal to the board when he sees it, rather than the functional qualities of the board itself.

So with those remarks I would like to, in behalf of you gentlemen out there, extend our thanks to the authors and the various other gentlemen who reviewed the papers for presenting us with a very interesting and highly informative session, and to you gentlemen out there I wish to thank you for your patience and kindness in being with us all day, and we hope to see you all again next year. Thank you, very much.

The meeting is adjourned.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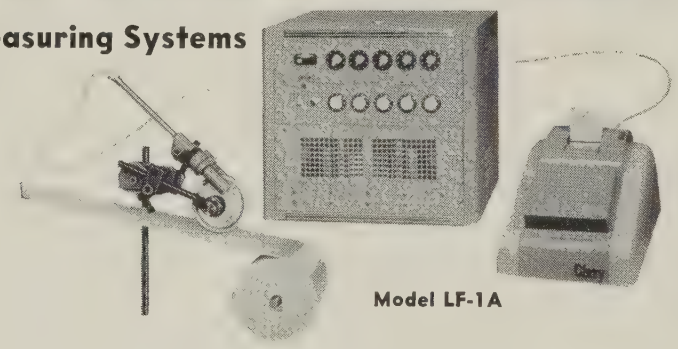

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# LOCAL SECTION ACTIVITIES

*Reports of Meetings, Personnel and Events*

## *Ohio*

The April meeting of the Ohio Section of TAPPI was held at the American Legion Hall in Middletown, Ohio, on Tuesday, April 14. The membership enjoyed a highly informative talk by E. S. Skinner of the Beloit Iron Works who spoke on the "Inverformer." The speaker elaborated on the machine's operations and productivity and its adaptability to multi-ply grades.

The following men were nominated and elected for office for the year 1959–1960:

*Chairman*—Virgil Perry, Harding-Jones Paper. Co.
*Vice-Chairman*—Chas. S. Sweitzer, Diamond-Gardner Corp.
*Treasurer*—Ed Suchecki, National Starch Products
*Recording Secretary*—George Martin, Champion Paper & Fibre Co.
*Corresponding Secretary*—Stanley W. Trosset, Jr., Diamond-Gardner Corp.
*Program Chairman*—Burton Bailey, Mead Corp.
*Executive Committee*—
Wm. Aiken, Diamond-Gardner Corp.
Ellsworth Shriver, Mead Corp.
Malcolm Lyon, Champion Paper & Fibre Co.
George Gregg, Cincinnati Gas & Electric Co.
Frank Cessna, Sorg Paper Co.

On May 14, the Ohio Section will meet at the Hartwell Country Club in Cinncinati for the Annual Ladies' Night Program.

FRANK L. CESSNA, *Recording Secretary*

## *Empire State (Central District)*

On April 3, 1959, the Central District of the Empire State Section of TAPPI met at the Armstrong Cork Co. for it annual plant tour. Approximately 100 people attended. Following the tour, dinner was served at the Fulton Chamber of Commerce; and John Schuber spoke to us of the founding of TAPPI.

MARIE M. MARTIN, *Secretary*

## *Golden Gate District*

The meeting of the Golden Gate District of TAPPI was held on Tuesday, March 31, at C&H Sugar Corp., Crockett, Calif., and 130 men enjoyed the hospitality of this good company both so far as the plant tour was concerned and also refreshments and dinner.

The primary purpose of this meeting was to discuss materials handling and, consequently being able to see the new Lamson equipment in operation at C&H was of extreme interest.

A delightful social hour and dinner was enjoyed as the guests of C&H. George Aljian, vice-president, acted as host.

The talk of the evening was given by Bert C. Kendall who replaced Mr. Helverson of Crown Zellerbach Corporation.

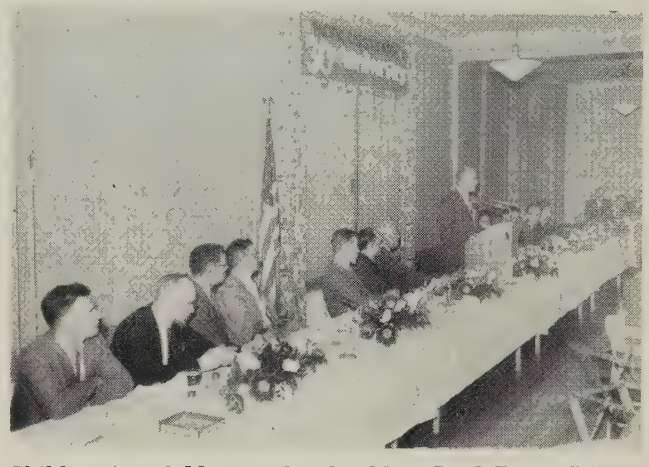
H. A. HARVEY, *Secretary-Treasurer*

## *Pacific*

TAPPI's 21st annual Shibley Award Contest was held at Camas, Wash., April 7, 1959. A well attended meeting listened to four contestants present the following papers:

1. "The Frag Tester—A Design Tool for the Sack Maker," by Sangho Back, Central Research Dept., Crown Zellerbach Corp., Camas, Wash.
2. "Some Aspects of Towel Manufacture," by J. P. Bell, Westminster Paper Co., New Westminster, B. C.
3. "Scrubbing Kraft Recovery Furnace Gases," by J. S. Murray, Kraft Mill, Weyerhaeuser Timber Co., Everett, Wash.
4. "Case Sealing at the Camas Converting Plant," by Richard L. Carlson, Crown Zellerbach Corp., Camas, Wash.

Norman S. Lea, Scott Paper Co., Everett, Wash., who is immediate past-chairman of the Pacific Section, moderated the program. Following the social hour and dinner, Mr.



***Shibley Award Meeting head table: Paul Frost, Robert Smythe, F. O. Boylon, Walter Meyer, Norval Magnusson, Philip Nethercut, Paul S. Billington, Norman S. Lea, Sango Back, J. P. Bell, Richard L. Carlson, and Jack S. Murray***

***Past chairmen of the Pacific Section. Back: Carl Fahlstrom—1937, Norman S. Lea—1957, Fred J. Weleber—1953, George H. McGregor—1938. Front: Ben T. Briggs—1956, John M. McEwen—1955, N. W. Coster—1939–40, C. A. Enghouse—1943, H. W. Bialkowsky—Not shown***

*Shibley Award participants: Jack S. Murray, Weyerhaeuser Timber Co.; Richard L. Carlson, Crown Zellerbach Corp.; Norman S. Lea, moderator, Scott Paper Co.; James P. Bell, Westminster Paper Co.; Sango Back, Crown Zellerbach Corp.*

Lea announced the winner of this year's Shibley Award and presented a check to Sango Back. Individual presentations were made also to the other contestants.

This being the Pacific Section's 30th anniversary, a special program honoring the past-chairmen was planned. Past-chairmen present were Carl Fahlstrom, G. H. McGregor, N.

*Norman S. Lea congratulates Shibley Award winner, Sango Back*

W. Coster, C. A. Enghouse, H. W. Bialkowsky, Fred Weleber, John McEwen, Ben T. Briggs, and N. S. Lea. Special tribute was paid these men who contributed so much to the growth and strength of our section. Chairman Paul Billington presented each of them with an engraved gift as a token of appreciation of our membership.

Further highlighting the dinner program was Philip Nethercut, secretary-treasurer of TAPPI. He was introduced by Vice-Chairman Norval Magnusson and presented an interesting and informal talk outlining the aims of TAPPI for the future.

Credit for an exceptionally fine arrangements job goes to Paul Frost for his conscientious attention to every detail.

ROBERT SMYTHE, *Secretary-Treasurer*

## *Virginia-Carolina*

This second winter meeting of the Virginia-Carolina Section was held at the Thomas Jefferson Hotel in Richmond, Va. The afternoon session consisted of the following:

Otis Witworth, Paper Machine Division of the Black-

*Speakers table at the Virginia-Carolina Section meeting: R. E. Carrel, Continental Can Co.; Clark Snook, NOPCO Chemical Co.; William Chapman, Union Bag-Camp Paper Corp.; R. F. Miller, Continental Can Co.; Dr. Robert Allen, National Home Study Council; Otis Witworth, Black-Clawson Co.; B. E. Majani, Black-Clawson Co.*

Clawson Co., presented a paper entitled, "Developments in Paper Machine Drives." He stressed the improvements in the hydraulic control in their differential drive and also delved into the use of nylon belting.

B. E. Majani of the Dilts Division of the Black-Clawson Co., presented a paper entitled, "On and Off Machine Coating." Mr. Majani described the various methods of coating and discussed the advantages and disadvantages of the various methods. He showed a color movie of their new trailing blade coater.

B. LaTouche, Jr., of the Continental Can Fibre Drum & Corrugated Box Div., Richmond, Va., gave a paper entitled, "Importance of Quality Roll Stock in the Manufacture of Corrugated Containers." Mr. LaTouche mentioned some of the problems that the box plants run into in off-quality roll stock.

A business session was held before dinner and Clark Snook and E. L. Dozier were appointed as co-chairmen of the Nominating Committee for the 1959–1960 slate of officers.

*Standing: William Chapman, Union Bag-Camp Paper Corp.; R. F. Miller, Continental Can Co.; W. A. Green, Jr., Manchester Board & Paper Co.; B. LaTouche, Jr., Continental Can Co. Seated: B. E. Majani, Black-Clawson Co.; E. L. Dozier, Chesapeake Corp. of Va.; Clark Snook, NOPCO Chemical Co.*

*Virginia-Carolina Section dinner*

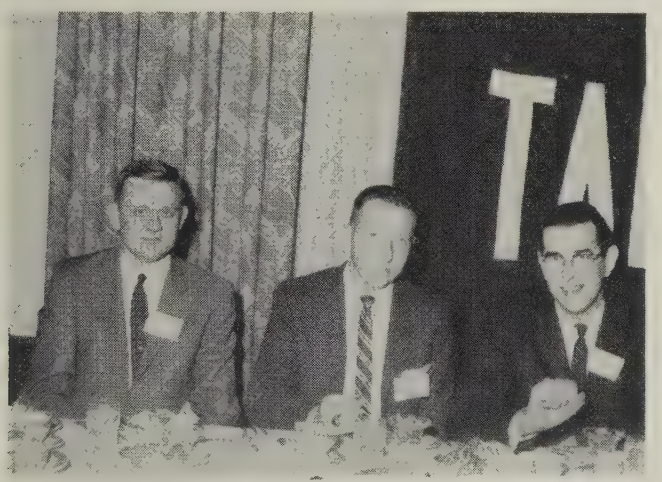
After the social hour and dinner M. Robert Allen, executive director of the National Home Study Council in Washington, D. C., gave a thought provoking talk entitled, "The Importance of Communication in Industry," A lively discussion followed.

R. F. Miller, *Vice-Chairman*

## *Southeastern*

The March meeting of the Southeastern Section was held at the Francis Marion Hotel in Charleston, S. C., on March 20–21. The International Paper Co. of Georgetown, S. C., was the host mill. J. F. Mixson, mill manager at Georgetown, welcomed the group to the meeting. A social hour and banquet was held on Friday night prior to the presentation of the technical papers. Three papers were presented. P. E. Wrest, manager of paper manufacturing research of The Mead Corp., Chillicothe, Ohio, gave the first paper entitled "Hydrodynamics and Papermaking." The second paper was given by J. C. Thurmond and O. J. Bristow of Union Bag-Camp Corp. at Savannah, Ga. Their paper "Reduction of Mist-Type Entrainment Losses in Pulp Mills" was an awards content entry. The third and featured paper was given by Malcolm N. May of the Gulf States Paper Corp., Tuscaloosa, Ala. Dr. May's paper was entitled "Some Qualitative Remarks on Basic Fiber Properties of Interest in Paper Strength." Nearly 140 attended the technical program.

On Saturday morning a tour was made of the International Paper Co. mill at Georgetown. Over 80 made the tour.



*J. F. Mixon, International Paper Co.; J. C. Thurmond and R. R. Chase, Union Bag-Camp Paper Corp.*

*Executive Committee, Southeastern Section. Seated: Robert Flick, Brunswick Pulp & Paper Corp.; R. R. Chase, Union Bag-Camp Paper Corp.; David Wetherhorn, Southern Paperboard Corp. Standing: J. B. Doughty, West Virginia Pulp & Paper Co.; M. J. Maynard and R. E. Millar, Union Bag-Camp Paper Corp.; B. M. Reaves, Sonoco Products Inc.; and P. E. Nethercut, TAPPI*

The group was served a lunch following the tour, compliments of the International management.

Phillip Nethercut, our new TAPPI secretary-treasurer, spoke briefly to the group on Friday night.

J. B. Doughty, *Secretary*

### Reduction of Mist-Type Entrainment Losses in Pulp Mills

*J. C. Thurmond and O. J. Bristow*

In the average pulp mill there exists a number of small chemical losses which, when considered individually, appear so small that their elimination with such conventional equipment as scrubbers or cyclones cannot be economically justified. In some areas it has been necessary to eliminate some of these losses, regardless of the economics, because of pollution problems. In areas where there are little or no pollution problems, the losses have been allowed to continue either because of the difficulty of justifying the expenditure for equipment or because of the lack of definite knowledge of the locations and magnitudes of the small losses. When totaled, these become an appreciable percentage of the chemical makeup of the average mill. It would not be possible to provide a complete list of the sources of small losses for all mills but some examples are: Multiple-effect evaporator entrainment, recovery unit dissolving tank vents, uncapped blow tank vents, pulp washer vacuum headers, and condenser vents. In addition to this partial list, there are probably a number of vents peculiar to certain mills where such losses occur. Many of these will probably continue to require expensive equipment for their elimination and will therefore continue to exist for some time to come. Some of them, however, can be stopped or greatly reduced by inexpensive equipment, and with a net monetary saving to the mill involved. One such type of equipment and its application are discussed below.

#### WIRE MESH ENTRAINMENT SEPARATOR

At the Savannah plant of Union Bag-Camp Paper Corp. some of the small losses mentioned above were known to exist for a number of years. Since the installation of additional equipment to reduce the losses could not be justified readily, they were minimized only by giving attention to the operation of the equipment causing the losses. However, in early 1958, a simple and inexpensive type of entrainment separator

J. C. Thurmond, Engineer, and O. J. Bristow, Engineer, Union Bag-Camp Paper Corp., Savannah, Ga.

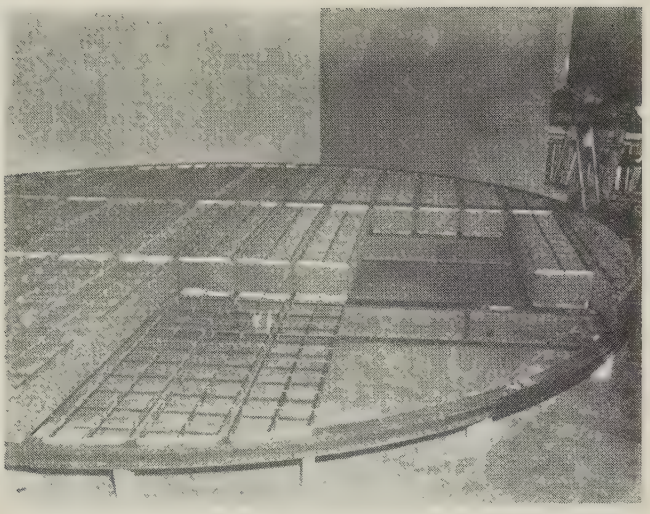


*Fig. 1*

was tried. Supplied by Otto H. York Co., Inc., and called the "Demister," it consists of a mat of many layers of woven wire mesh supported by a grid (Fig. 1). Several materials of construction are available including stainless steel, which has been found satisfactory for the applications described herein. The mat can be fabricated to fit the entire cross-sectional area of a vessel, vapor line, or vent. It had been found that such a mat was very effective in removing mist-type entrainment from a vapor stream. This results from the impingement of liquid droplets on the wire strands of the mat and subsequent conglomeration of the droplets into a liquid of sufficient weight to flow downward along the wire strands through the mat. Upon reaching the bottom of the mat, the liquid has sufficient mass to flow against the gas stream either as large drops or as steady streams. With the mat installed in a horizontal position over a liquid subject to entainment, the recovered liquid simply falls back into the vessel from which it came. Therefore no pumps, piping, or traps are required. The resistance of the mat to gas flow in ordinary applications is very low and the pressure drop through the mat in a typical application is less than one inch of water. The separation efficiency of the device is usually very high, as pointed out later.

It is obvious why the wire mesh-type entrainment separator has a substantially lower first cost than most separators. It contains no moving parts, generally requires no special fabrication or modification of the equipment it is to serve, requires no extensive spray nozzles or other piping, and is of relatively simple construction. This comparatively low first cost, together with high efficiency, makes the device particularly suited for "small loss" applications.

Several applications for wire mesh entrainment separators have been evaluated at the Savannah plant and this work is continuing. Two applications have met with particular success thus far and will be discussed in some detail.

## MULTIPLE-EFFECT EVAPORATOR ENTRAINMENT

Many black liquor evaporators in use at kraft mills today are of the long tube vertical type with "backward feed." The weak black liquor feed is pumped to a high vacuum effect where, because of the sudden change in temperature and pressure, violent flashing occurs. This situation is very conducive to mist-type entrainment, and, since conventional centrifugal catchalls are usually incapable of removing all of the mist, part of it is lost with the vapor from the effect. Some evaporator manufacturers have alleviated this problem on new equipment by changing the feed point, but a large number of evaporators remain with entrainment problems.

A series of tests on two large evaporators at the Savannah plant showed a black liquor loss equivalent to about 2 lb. of saltcake per ton of pulp to be occurring during

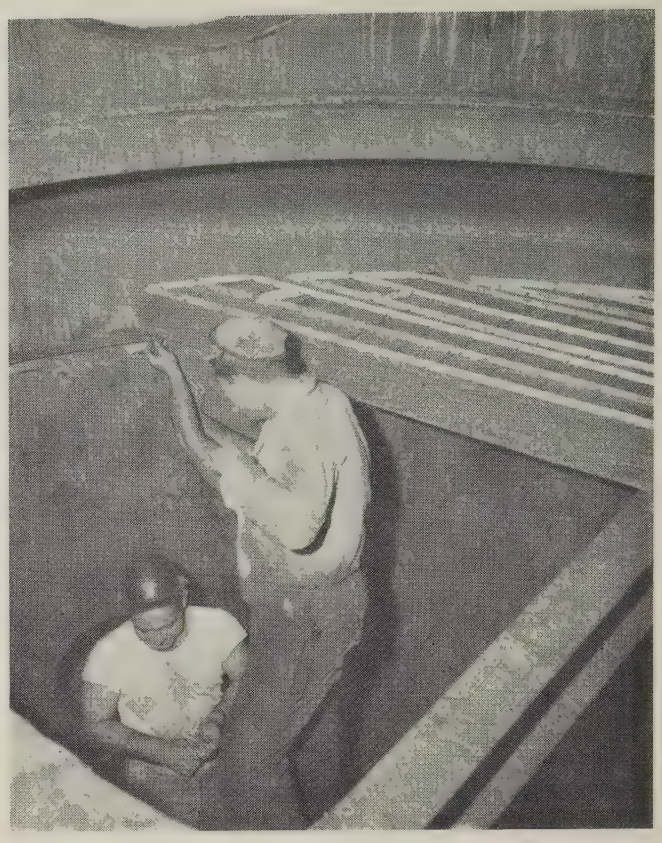


*Fig. 2*

normal operation due to entrainment in the last (feed) effect. This entrainment liquor left the evaporator with the vapor and was lost in the direct contact condenser which operates on river water. The loss was held to the above value by maintaining the last effect vacuum at a point less than the maximum possible. This reduced the available temperature drop through the evaporator and resulted in less than maximum evaporative capacity.

A wire mesh entrainment separator was installed for evaluation in the vapor dome of the last effect of one of the evap-

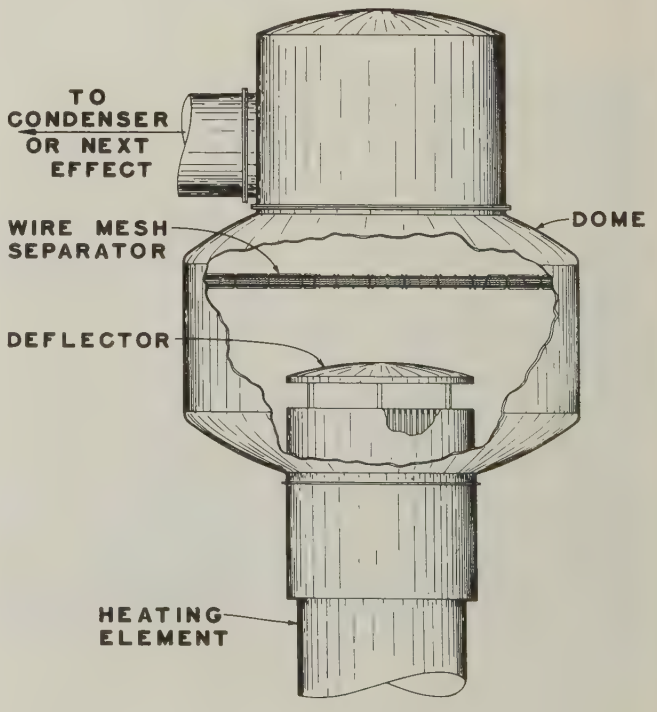



*Fig. 3*

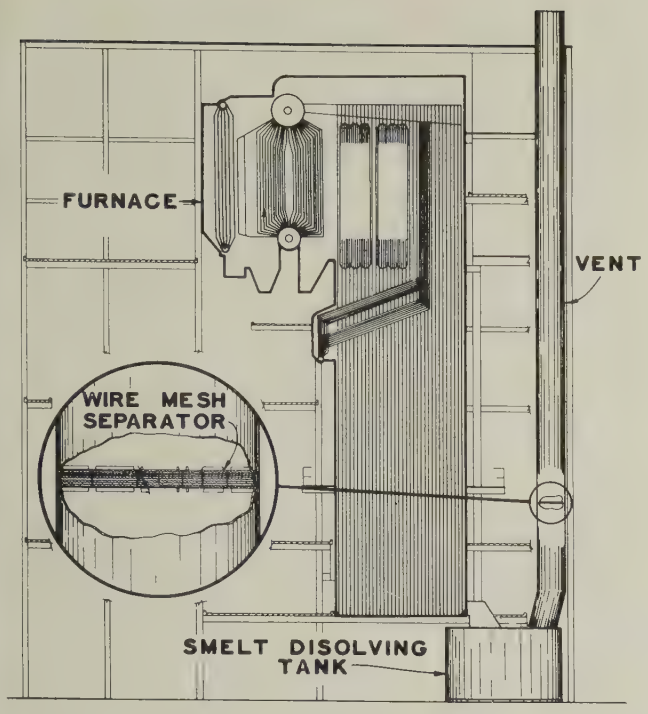



*Fig. 4*

orators. The entire cross-sectional area of the dome was covered with the mesh (Fig.-2 and 3).

The results of the installation were excellent. While severe mist entrainment could be observed through sight glasses in the dome below the mat, the area above the mat was very clear. Test results confirmed that the black liquor loss had been practically eliminated.

While the elimination of the loss provided a satisfactory economic justification for the installation, an additional benefit proved to be of more value. Because of the much lower tendency for entrainment losses, it was possible to increase the evaporative capacity of the unit by over 10%. Since there had been insufficient evaporator capacity for optimum economic saltcake recovery under all conditions of pulp production, the added capacity resulted in substantial saltcake savings in the pulp washing operation. After the success of the trial installation, additional separators were obtained for use in other evaporators.

### RECOVERY UNIT DISSOLVING TANK VENTS

The smelt from kraft recovery furnaces when flowing into dissolving tanks produces a violent reaction conducive to entrainment. Usually the smelt stream is broken up by a "shatter nozzle" before entering the surface of the liquid in the tank, and this adds to the likelihood of small particles or droplets being formed. Venting of the tanks is necessary to carry off the steam and gases formed and the natural draft effect of the vent is sufficient to cause a small entrainment loss. Several tests made on these vents indicated that the equivalent of about 2 lb. of saltcake per ton of pulp was being lost during normal operation. In addition to the monetary consideration, the discharge from the vents was capable of producing personnel discomfort under some atmospheric conditions because of the caustic mist.

There was some doubt about a wire mesh mist separator functioning satisfactorily in a dissolving tank vent, for two reasons. First, since the vent depends on natural draft for its operation the introduction of even a slight obstruction to flow may cause a pressure higher than atmospheric to result in the dissolving tank, with resultant "puffing" from the smelt spout opening. Second was the possibility of rapid plugging of the mesh with solids. It was decided to try a coarse weave separator with the expectation that the pressure drop across it would not be excessive, since the use of a fan and attending vent modification was not readily justified by the value of the loss. It was felt that if plugging of the mesh with solids became a problem it could probably be overcome by the use of a water shower to wash the mesh periodically. Accordingly, the installation was made in one vent for evaluation (Fig. 4).

Because of the low cost of the installation, the economic pay-off period was very atrractive and justified equipping the other units in the mill. The intangible benefit of improved personnel comfort was also realized. It is possible for a man to stand near the vent discharge without experiencing the severe discomfort that occurred because of the caustic mist.

### OTHER APPLICATIONS

An investigation is continuing to find other feasible applications for the wire mesh entrainment separator. As would be expected, it is not suitable for all types of entrainment problems. An example is foam entrainment. An attempt was made to eliminate black liquor entrainment through the vacuum system of kraft pulp washers with the separator. The nature of the entrainment at the location of the separator was not known but it was suspected that it might be foam. The separator did not eliminate the entrainment that occurred in this system under some conditions of washer operation.

It is expected that continuance of this work will point out other locations of small losses where expensive recovery equipment is out of the question, but where simple low-cost equipment such as the wire mesh separator can be justified in terms of savings alone.

Presented at the meeting of the Southeastern Section of TAPPI held in Charleston, S. C., March 20–21, 1959.

## Some Qualitative Remarks on Basic Fiber Properties of Interest in Paper Strength

*M. N. May*

I MUST apologize at the outset for the qualitative nature of my remarks, but I wish to speak rather generally about some work now proceeding at The Institute of Paper Chemistry with which I was formerly associated.

There are increasing indications that the fiber properties most significantly contributing to the strength of a sheet of paper or board fall into three general areas: (1) fiber strength; (2) fiber length; and (3) the capacity of the fibers to develop fiber bonding during the papermaking process. Fiber length is important because of its influence on stress distribution in the sheet; fiber bonding is important to resist the tendency of the fibers to separate from each other; and fiber strength is important to resist failure in the fiber themselves.

With the possible exception of fiber strength, these are factors which have been long considered important by papermakers. That fiber strength is also important has been conclusively shown by studies at The Institute of Paper Chemistry in which fiber failure was directly observed and measured relative to fiber separation in the zone of failure during both tensile and tearing tests. As one might expect, it was found that relatively few fibers were broken at low levels of fiber to fiber bonding in the sheet, but an increasing percentage of the fibers failed as fiber to fiber bonding increased. Thus, in relatively lightly bonded sheets, fiber strength often may be of relatively little significance, while in highly bonded sheets fiber strength is often the limiting factor.

In selecting woods for pulping, it has long been a practice where strength is a principal concern to select a long-fibered species of wood. This is then pulped as selectively as possible to remove lignin and separate the fibers with the least possible attack on the carbohydrate fractions. Lignin, for reasons only

M. N. MAY, Gulf States Paper Corp., Tuscaloosa, Ala.

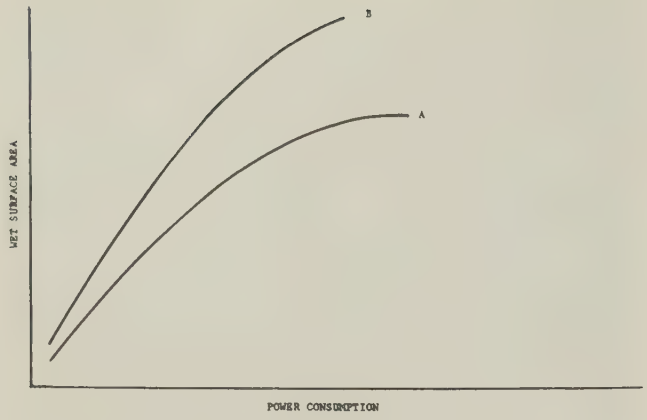



*Fig. 1*

*Fig. 3*

partly understood, tends to interfere with the development of fiber to fiber bonding during the papermaking processes. It is usually desirable to preserve the hemicelluloses because of the benefit to yield and because certain hemicelluloses have been shown to be beneficial to the development of fiber bonding. Minimizing the degradation of the cellulose tends to minimize the loss of fiber strength. The pulping process has relatively little effect on fiber length, although the preparation of the wood for pulping may have a significant effect on fiber length. You will, of course, recognize that I am greatly oversimplifying some very complex ramifications, but I wish to show how wood selection and pulping objectives are slanted toward the three areas of fiber properties which I have enumerated.

Considering now the beating and refining processes, the primary changes in basic fiber properties lie in those influencing the ability of the fibers to develop fiber bonding and in fiber length changes. Through most of the beating cycle, the strength of the fibers is essentially unchanged. In most cases, the primary objective in beating or refining is to develop fiber properties conducive to fiber bonding. The other effects are secondary and are for the most part deleterious.

Of importance to the development of bonding is the creation of surface and the specific effectiveness of this surface in forming fiber bonds upon drying. Bonding effectiveness per unit of wet surface area appears to be highly dependent on the physical chemistry of this surface—this is at least in part influenced by the chemistry of the fibers, but it also appears to be influenced by the nature of the beating.

If the fibers are so constituted as to be resistant to the creation of surface, considerable power will be consumed in the beating operation. If the surface formed is not conducive to good fiber to fiber bonding, this will be reflected in the strength properties. It should be kept firmly in mind that surface may be easy or hard to create and that the resulting surface may be either effective or ineffective from a fiber-bonding standpoint. Fiber strength appears to be at least one factor influencing the amount of power required to create a given amount of wet surface area, but there is no necessary relationship between fiber strength and the effectiveness of the created surface for bonding.

Fiber strength also appears to influence the rate at which fiber length is reduced during beating. That is to say, a given power input will produce a greater fiber length change in weak fibers than in strong fibers.

The work of Bill Ingmanson, Stan Mason, and others has shown that the drainage behavior of fibers is established by the external surface area, their swollen volume, and their compressibility. The filtration resistance of fibers is a function of the square of the external surface area. Thus, the creation of surface area *per se* during refining has a very adverse effect on drainage behavior. Therefore, one should strive to develop the best possible capability for fiber to fiber bonding with the least possible creation of surface. There are some indications that this can be done by striving to increase the swollen volume of the fiber while striving to minimize surface area creation *per se*. In other words, to develop the best possible tensile or bursting strength with the least possible sacrifice in tearing strength and with the least possible sacrifice in drainage behavior, one should strive in refining to put the work into effective swelling or fibrillation of the fibers with the least possible fiber length reduction and with the least possible creation of surface area.

Some qualitative curves may help to illustrate these points. In Fig. 1, the development of wet surface area with increasing power consumption is illustrated for two hypothetical cases. B develops surface with less power consumption than A; however, the surface developed by B may or may not be good for bonding. This is illustrated in Fig. 2 where B-1 and B-2 are

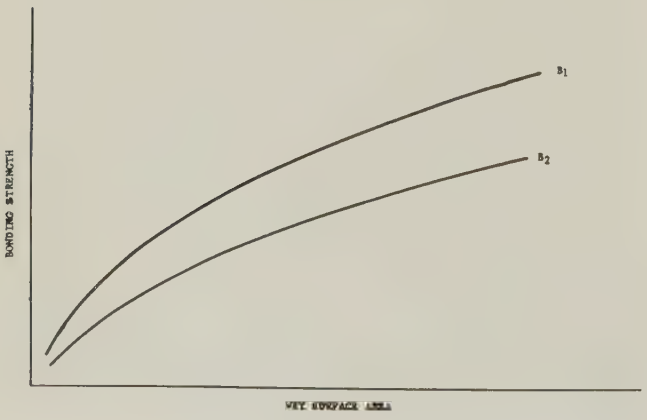



*Fig. 2*

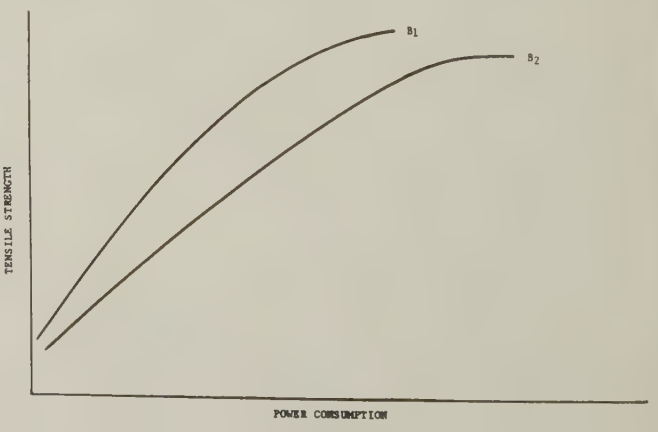



*Fig. 4*

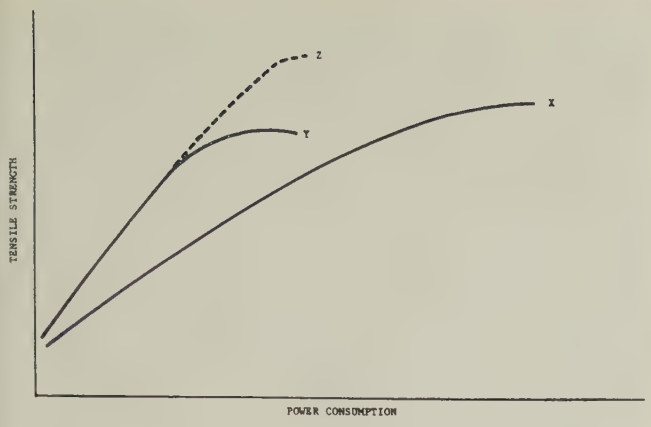



*Fig. 5*

quite different in bonding strength at a given wet surface area. Because of the strong influence of surface area on freeness, B-2 must be refined to a much lower freeness to develop a given level of fiber bonding. This is illustrated in Fig. 3. The impact of these bonding strength differences on tensile strength is illustrated in Fig. 4 where B-2 requires much greater power consumption to achieve a given level of tensile strength than B-1 and with some sacrifice in maximum developable tensile strength, since even if the two were of the same fiber strength, the greater power consumption required by B-2 to overcome the bonding deficiency would result in an increased fiber length reduction. Figure 5 gives another look at the interaction of these fiber properties on tensile strength. Y develops fiber bonding with less power consumption than X, but the maximum developable tensile strength in Y relative to X is limited by either fiber strength or fiber length or both. A greater fiber strength and/or length in Y would result in curve Z.

If this were all there were to the matter, we could simply say, "let's strive to maximize fiber strength, fiber-bonding capacity, and fiber length in those cases where we wish to maximize all strength properties." Bursting strength, tensile strength, and folding endurance do appear to be benefited by increasing all three of these families of properties. Tearing strength, however, although beneficially affected by increasing fiber strength and fiber length, generally decreases with increased fiber bonding, Thus, one must be cautious against overemphasis on the fiber bonding area. Stating this a little differently, if one can achieve tensile strength, burst, and fold by promoting fiber length and fiber strength, one can minimize the amount of fiber bonding necessary, and this will generally be to the advantage of tearing strength.

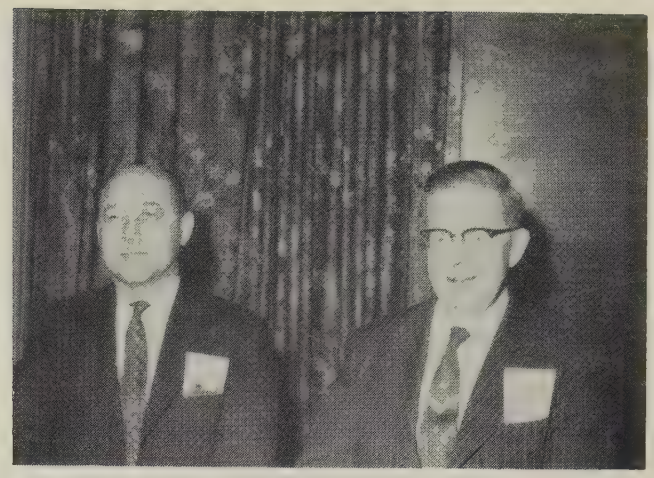
To summarize, where sheet strength is the primary concern, it appears desirable to develop pulps with good fiber strength, good fiber length, and which, upon refining, will develop the required amount of fiber to fiber bonding with the least possible creation of surface and with the least possible power consumption in creation of surface. To this end, refining methods should be selected which will promote fiber bonding with the least possible creation of surface, with the least possible power consumption, and with the least possible reduction in fiber length.

Presented at the meeting of the Southeastern Section of TAPPI held in Charleston, S. C., March 20–21, 1959.

## *Gulf Coast*

The Gulf Coast Section of TAPPI met at the Battle House in Mobile, Ala., on March 13, 1959. There were 103 in attendance. Harry Roller, Jr., from Public Relations of International Paper Co. welcomed the group and gave directions for the mill visit to Moss Point on Saturday morning, March 14.

At the business meeting the nominating committee com-



***W. P. Shannon, St. Joe Paper Co. and J. E. Doyle, St. Regis Paper Co.***

posed of Vincent Waters, W. P. Shannon, and Louis A. Thompson submitted the following slate of nominees which will be voted on at the annual meeting, May 15:

*Chairman*—William Elsevier, International Paper Co., Mobile, Ala.
*Vice-Chairman*—Al Hargraves, St. Joe Paper Co., Port St. Joe, Fla.

***H. M. Roller, Jr., International Paper Co.***

***E. R. Hendrickson, University of Florida***

*Secretary*—Normal LeMaistre, Container Corp. of America, Brewton, Ala.
*Treasurer*—Medie T. Still, St. Regis Paper Co., Pensacola, Fla.
*Executive Committee*—Robert R. Fuller, Gulf States Paper Corp., Tuscaloosa, Ala.; Ion S. Walker, International Paper Co., Mobile, Ala.; J. Edward Doyle, St. Regis Paper Co., Pensacola, Fla.

***M. T. Still, St. Regis Paper Co. and E. F. Thode, The Institute of Paper Chemistry***

The program chairman, M. T. Still, presented the following program:

"Five-Day versus Seven-Day Operation," W. P. Shannon, St. Joe Paper Co.
"Air Sampling and Testing," E. R. Hendrickson, University of Florida.
"Dynamic Process Control," Edwin F. Thode, Institute of Paper Chemistry.

Saturday morning, March 14, the group enjoyed a fine tour of International Paper Co. mill at Moss Point.

J. E. Doyle, *Chairmen*

Presented at the meeting of the Gulf States Section of TAPPI held in Mobile, Ala., March 13, 1959.

## Five-day Operations versus Seven-Day Operations

*W. P. Shannon*

In order to clarify at the beginning, I will preface this paper with the remarks that there are many problems that we haven't solved, and many intangibles that we will not be able to cover as we have no way of knowing what damage intermittent operations have done and will do to much of our equipment. Also I would like to point out that this paper is presented with the idea of a question and answer period rather than try to cover all problems both human and mechanical.

During 1958, like most of the paper industry, we began operations on short periods of taking a week or 10 days downtime to build up enough orders to operate as long as we could until the orders ran out, and when business did not pick up in the 3rd quarter, we started a study of operating on a basis of 5 days a week. In the 4th quarter of 1958 we went on a 5-day operating schedule. We began by shutting down at 7:00 a.m., Saturday morning, and starting up at 7:00 a.m. on Monday morning. We found after three weeks that we were not able to continue our preventive maintenance program because of the many additional problems we faced on equipment failures on start-ups in various departments. So on the basis of our experience of three weeks on 5-day operations we reconsidered our scheduling of operation, in order to provide 8 hr. maintenance with the day maintenance force without involving overtime.

We worked out a new schedule of operation whereby our maintenance force would come in at 7:30 a.m., Monday morning, and our operating crews come in at 3:00 p.m., Monday, and work until 3:00 p.m. on Saturday. This schedule permitted us to take care of the additional maintenance such as steam leaks, checking out equipment, etc.—permitting us to keep up with the additional maintenance involved in shutting down weekly. Not being able to project how long we would be on curtailed production, and in order to provide 40 hr. work for operating personnel, we reduced our forces by one complete shift, with the exception of the power department, recovery room, and operating electricians.

In the power department and recovery room we found it more economical to maintain skeleton crews during down time to keep our boilers hot and not face the problem of additional maintenance from leaks in steam lines and hand holes in recovery and power boilers, which we invariably ran into when we shut these units down cold. By keeping these units hot over the week end and maintaining one turbine on the line for power, we found that we had an increase of 0.3 barrel of fuel oil per ton, which we felt more than offset the additional maintenance that would have been required if the units were allowed to be shutdown cold, and at the same time maintain fire protection and power throughout the mill.

In outlining some of the problems, we found that we had to make studies on wood purchases and receipts in order to avoid demurrage, by not being able to unload over week ends without incurring overtime.

W. P. Shannon, Production Manager, St. Joe Paper Co., Port St. Joe, Fla.

Through the concerted efforts of our Woodlands Division and our vice-president in charge of manufacturing, we have been able to maintain an adequate inventory and schedule receipts so that we have kept demurrage to a minimum and have been able to turn our inventory around and avoid the accumulation of too much old wood.

We also found it necessary to make a complete study of our bulk chemicals such as salt cake, lime, alum, etc., and to set up delivery dates that would permit us to unload these chemicals Monday through Friday to avoid demurrage and overtime. This took a great deal of cooperation between the purchasing department, laboratory, and our suppliers. We think that we have succeeded in solving this problem, as our demurrage to date is no higher than it normally ran under a 7-day week operation.

Our pulp mill operations presents one of our greatest problems. We found it necessary to plan our pulp mill operation to a minute detail to avoid shortage of liquor and loss of excess chemicals. This planning starts on Tuesday following starting up on Monday. Inventories of green liquor, white liquor, heavy black liquor, and weak liquor are checked, then the pulp mill superintendent projects his use of salt cake make-up over the next four days. To bring his liquor system back into balance by Saturday at 3:00 p.m., his losses during the previous week on evaporator boilouts, washing precipitator bottom, and sewer losses are taken into account in this projected figure. Again on Thursday another inventory is taken and compared with his projected position to determine if any changes have to be made in order to have his balance correct on the shutdown on Saturday, taking into consideration that his weak black liquor tanks should be at a low level to permit the wash room to start up efficiently. We have found that our average increase in salt cake losses has been approximately 30 lb. per ton compared to 7-day operation. Our fresh lime usage increased 3 lb. per ton, our water usage increased 7000 gal. per ton, steam increased 4000 lb. per ton and an increase of 50 kw.-hr per ton.

One of the main problems on the stock side is putting digesters on at the same time that the whole mill is being brought on line. This brought about a considerable shortage of steam at the beginning and delayed our cooking which actually hampered paper machine operation the first 24 hr. on Monday; however, we found that we could charge our digesters prior to shutting down on Saturday and bring the steam pressure up to 40 to 60 lb. and leave them under pressure over the week end without any effect on the quality of the cook (if anything an improvement was noted). This permitted us to put our digesters on without putting too heavy a steam demand on our power department and yet permitting us to blow much quicker. This permits the wash room to get on line by 4:00 p.m. on Monday and with the amount of stock in high density storage and stock chests we are able to put our machines on line as soon after 3:00 p.m. as ready.

At the beginning of these wash room start-ups we faced a serious foam problem by reason of cold liquor. To overcome this we double the amount of Dow Corning antifoam in our black liquor, which minimized our foaming problem. This in conjunction with leaving our blow tanks at a low level and blowing hot stock in the blow tanks before starting the washers reduced this operation to normal.

With respect to the paper mill operations we found that the same minute planning was essential there as well as in the pulp mill.

All clothing changes are scheduled on Monday before 3:00 p.m., in order to get as much operating time in within the 5-day week as possible. We found it more economical to remove clothing before normally scheduled in order to avoid machine downtime during the 5-day operation. By doing this we increased our over-all clothing cost approximately $0.15 per ton, however we felt that the additional volume of tonnage offset this increase.

We found it necessary to use bactericide to prevent deterio-

ration of press felts while machines were idle. After we started using bactericide normal felt life was experienced except when a felt is close to its schedule change on Mondays. From all indications a drier felt deteriorates to a greater extent while a machine is down than it does operating; however, we have been fortunate in getting normal life out of our drier felts, but we do take a certain amount of chance on losing the felts while operating.

One of our major problems from the paper machine operating five days is foreign material, dead stock, and dry stock that is dewatered during the week-end shutdown. In order to start immediately after 3:00 p.m. on Monday, we leave our machines stock chest full and agitating, this does not permit us to wash out all stock lines. Also we face the problem that most of the mill face—that is, black iron pipe in most of the lines, with the exception of lines directly before the machines. This causes a considerable amount of rejected paper and lost time during the first shift operation after starting. In fact this condition stood out so greatly that we decided to install screens ahead of the machines, not only for 5-day operation, but we feel that they will more than justify themselves on 7-day operation.

Another problem that we faced was scheduling the most efficient grades for starting up and shutting down, and yet fulfill our committments to our customers. By planning our warehousing storage facilities, we are able to do this most of the time.

From our experience to date on cold start-ups on electrical equipment, we found it necessary to install permanent strip heaters in all essential motors. During the past 10 months we have completed this and even under very adverse weather conditions we only find three or four motors that do not meg up by reason of moisture, and these are quickly dried out with portable hot air driers.

We have not experienced any excessive insulation failures due to excessive moisture since completing our permanent strip heaters. Working the shift electricians on a skeleton crew basis permits us to start megging motors at midnight on Sunday night and put additional heat on them if required.

In our paper machine room we leave enough hot air fans running to keep the building warm, and we do not experience any difficulty with motors in this location, with the exception of the extreme wet end stock pump motors. Most of this trouble is caused by washing up and water standing on floors.

From our experience at St. Joe, I believe it would be very feasible to design or convert a mill for 5-day operation and operate it efficiently with proper chemical recovery from shutdown of evaporators, precipitators, and lime kilns; with adequate heating and insulation on storage tanks this could be accomplished.

With regards to our personnel setup, when we knew that we were faced with a 5-day week operation, we spent a great deal of time and study trying to arrive at a minimum force with maximum efficiency to operate the mill. Our maintenance force had to be evaluated as to crafts, in planning the reduction. For example, we anticipated more leaks and therefore did not reduce pipe fitters in proportion to the number of days we were operating as compared to 7-day operation; however, we also anticipated that by achieving a full day's preventive maintenance work on Mondays, we would not experience as many mechanical breakdowns as on 7-day operations, and we were able to reduce the millwrights force more than the two-sevenths that we reduced operations. We also found that we could shift four operating electricians to day maintenance and actually reduce our electrical maintenance cost by a better preventive maintenance program than we had on 7-day operation. We discussed at length the possibility of reducing our shift supervisors, such as tour foremen, but after our first three weeks we found that actually it more than paid for itself to have the additional foremen on start-ups and shutdowns.

In conclusion I might add that our process engineers were assigned to each department to work with the department head and his foremen to work up procedures for shutting down and starting up. This proved to be very effective.

Now to summerize our major problems; I would say they follow in this order: (1) coordination and planning by all departments, (2) preventive maintenance programs, (3) chemical losses, and (4) paper machine lost time.

We have accumulated some comparison cost figures of 5-day versus 7-day operations, but not enough to correlate for accuracy; however, I will be glad to give you some idea of the trends.

Presented at the meeting of the Gulf States Section of TAPPI held in Mobile, Ala., March 13, 1959.

## Air Pollution Sampling and Analysis with Special Reference to Sulphate Pulping Operations

*E. R. Hendrickson*

As all of you know a great deal of interest has been aroused in recent years concerning pollution of the atmosphere by industrial effluents. A number of states have passed or are considering air pollution control legislation. You might reasonably ask why the sudden interest has developed in this problem. You know that pulp mills have been the target of localized complaints about odors and particle fallout. Until recently, however, no great seriousness was attached to these complaints. Newspaper and magazine articles appearing during the month of November, 1948, describe conditions in a small Pennsylvania milltown called Donora. This is the first air pollution episode in the United States which received a great deal of nation-wide publicity. Immediately following this publicity, the fountainhead of ballyhoo, Los Angeles, began to publicize its smog problem in the national press. These two instances were, I believe, the start of increased public interest in problems or air pollution whether or not they involved human heatlh.

Except in a few instances the pulp and paper industry has not been singled out as an industry involved in gross pollution. A few instances are on record, however, where individual members of the industry have been involved in law suits claiming paint damage, detrimental health effects, and odors. Since present conditions may not continue indefinitely, it behooves individual mills to take an interest in the materials they are discharing into the air and the ultimate fate of those discharges. This interest must extend to the point of keeping records of weather conditions and airborne discharges.

### CONTAMINANTS OF INTEREST

A number of contaminants are known to be of interest as contributing to possible air pollution problems resulting from sulphate pulping. These emissions include particulates which might be involved in materials or vegetation damage, gases which might be involved in vegetation damage and detrimental health effects, and the gases and vapors which might contribute odors. As pointed out in previous papers, the particulates may result from the recovery furnace, the bark burner, the power plant, and the calcining operation. Odorous gases may be released from the digester, the blow tank, the multiple-effect evaporators, and the recovery furnace. These gases include hydrogen sulphide, methyl mercaptan, dimethyl sulphide, and dimethyl disulphide. Gases of interest in materials damage and detrimental health effects may be released from the recovery furnace. These include hydrogen sulphide, sulphur dioxide, and sulphur trioxide. This information is familiar to all of you; however, information concerning the quantities involved is quite contradictory. It is not known whether this is due to process variables or to sampling techniques. The dearth of available data and statements from some of you gives strong evidence of a weakness in the latter.

E. R. Hendrickson, Research Professor, University of Florida, Gainesville.

## ATMOSPHERIC SAMPLING

It is becoming increasingly important for a mill to know what materials are being discharged into the air and what is happening to those materials. Atmospheric Pollution Technical Bulletin No. 1 was prepared by our laboratory and published by the National Council for Stream Improvement in September, 1957. The bulletin contains a critical review of the literature on procedures and analytical methods of value in determining compounds of interest from sulphate pulping operations. Many of these methods have resulted from extended studies by well-qualified investigators. Separation and analysis of various combinations of contaminants of interest is very difficult because the compounds are very reactive and some are easily oxidized. None of the available analytical methods were found completely suitable for evaluating air pollution. Many are quite involved and require a considerable amount of expensive equipment and considerable knowledge on the part of sampling personnel. It was decided, therefore, that new techniques should be developed which would be specifically applicable to air pollution investigations. It was further decided that it was unnecessary to determine the concentration of all of the compounds which might result in air pollution problems. It was believed suitable to investigate only general classes of materials as indicated previously.

To provide information which would be of value as a permanent record of what has been discharged from a given mill, sampling might be conducted at a number of locations. In general, the locations would break down into stack samples and areal samples. The initial work was started in the area of stack sampling with the recovery furnace being the first target. Since the items of interest are on the outlet side of any control devices, that location was selected for the preliminary work. It was believed desirable to use as many standard items of equipment and as many standard techniques as possible. In consultation with representatives from individual mills, a sampling program was developed. To provide adequate information while keeping the determinations as simple as possible, it was decided to sample for particulates, sulphur dioxide, hydrogen sulphide, and total sulphur as sulphur dioxide. By this procedure, other reduced sulphur compounds could be determined by difference.

## SAMPLING EQUIPMENT

The equipment used in this procedure is that commonly used in air pollution sampling. A sampling train was constructed consisting of a sample probe containing a Whatman paper thimble, three sets of fritted-glass scrubbers, three flow-measuring devices, and a source of vacuum. In the field equipment used, the source of vacuum was a compressed-air ejector. Materials used ahead of the collection points were stainless steel, Pyrex glass, and Tygon tubing. The sample probe was made of stainless steel, and had the filter holder directly behind the nozzle. The filter thimble was held in place inside the holder. Because of the high humidity which is encountered in the stack, it was necessary to either mount the filter holder within the duct or provide heat above 100°C. for the portion of the apparatus connecting the probe to the filter. It was felt that mounting the filter holder on the probe was the most satisfactory solution. After leaving the probe, the air stream was broken into three equal portions. Gaseous components were collected in fritted-glass scrubbing devices. The first train of scrubbers collected sulphur dioxide in 100 ml. of a medium consisting of 0.1 *M* sodium tetrachloromercurate. This is the reagent from the method of West and Gaeke. The second absorption train is intended to collect hydrogen sulphide by scrubbing in a solution consisting of 130 ml. of 1% zinc acetate with 5 ml. of 12% sodium hydroxide added. The hydrogen sulphide is fixed as zinc sulphide which precipitates from the solution. The third absorption train is preceded by a silica combustion tube maintained at a cherry-red heat. A small flow of pure oxygen is introduced at the inlet end of the furnace. By this means, it is intended to convert all of the reduced sulphur compounds to sulphur dioxide. The absorption train then is very similar to the first train in that sulphur dioxide is collected. The three flows are split through a heated stainless-steel manifold. The absorption trains are mounted in a special carrier for convenience in handling. Snap connectors made of Teflon permit the absorption trains to be readily disconnected from the rest of the equipment. The outlet end of each absorption train passes through a gas meter to which is attached a mercury manometer and a thermometer. The gas flow is then combined through another manifold which is connected to the source of vacuum. Sampling has been at the rate of 0.1 to 0.3 c.f.m. through each absorption train. Thus, the rate through the fiber is 0.3 to 0.9 c.f.m. Sampling at these rates has been conducted as long as 1 hr.

## ANALYTICAL PROCEDURES

The analytical techniques selected were also standard procedures. Sulphur dioxide was determined by the method of West and Gaeke in which the fixed disulphitomercurate is estimated by the intensity of the red-violet color produced when *p*-rosaniline hydrochloride-hydrochloric acid mixture and formaldehyde are added to the sampling solution. Any precipitate must be digested for 30 min. and removed by filtration. The concentration of sulphur dioxide is obtained by reference to a standard curve.

Hydrogen sulphide was determined by the method of Fogo and Popowsky. The precipitated zinc sulphide is redissolved in an acid solution and allowed to react with *p*-aminodimethylaniline sulphate in the presence of ferric chloride. This results in the formation of methylene blue in direct proportion to the amount of sulphide present in solution. It is necessary that the entire reaction take place in a closed container.

The particulates were determined by drying the loaded filter in a desiccator to constant weight and weighing. All concentrations were calculated to conditions existing in the stack.

As might be suspected, many problems were encountered in both the sampling and analytical techniques. Sampling rates on the preliminary work were generally found to be too high, resulting in excessive head losses. The amount of material collected was in many cases found to exceed the limitations of the reagent concentration. Therefore, sampling rates and duration were reduced for subsequent tests. A milky precipitate was found to occur in the sulphur dioxide collectors. The cause of this was unknown but it was believed that it may be a sulphide precipitate and, if so, could eliminate the sample train for hydrogen sulphide. Spectrographic analyses indicated that this precipitate was a complex including mercury thiochloride which was not produced quantitatively. The zinc sulphide was found to be a sticky precipitate which adhered to all surfaces tenaciously. A modified procedure using a zinc acetate solution slightly acidified with acetic acid may help solve this problem. In some instances the hydrogen sulphide concentration was so great that color formation was altered. A blue color would form which would be bleached rapidly to a pink color. In order to reduce head loss and eliminate other problems associated with the fritted-glass diffusers, special orifice-type scrubbers have been used in the recent work. Use of these scrubbers has resulted in additional problems which are not yet completely understood.

From the work thus far conducted, it is believed that these sampling procedures and analytical techniques have considerable merit and are worthy of investigation which will result in adequate and simple techniques. Laboratory experiments using controlled atmospheres are now being completed to determine the extent of interferences, the reproducibility of the methods, and limits of concentration which are allowable. It is hoped to complete this phase of the work with greatest possible speed so that techniques may be available to the industry in a short time.

## AREAL SAMPLING

Areal sampling is another place where individual mills can obtain valuable records of information which may help them in future actions. It may be of considerable assistance to know the general distribution of compounds which might result from individual operation. Records kept over a period of years could prove valuable in answering legal actions, as well as the demands of control agencies.

When faced with the need for sampling the atmosphere in the vicinity of an industrial operation, one usually first considers some device for collecting a known quantity of air and having it analyzed in the instrument or in the laboratory. If put into practice, this supposedly simple procedure not only presents problems of a technical nature, but raises a question of suitability. Will the results justify the means? In many cases they most certainly will. In others, the fact that $X$ micrograms of a given pollutant occur in every cubic meter of air sampled means little. Perhaps the effect of that concentration of pollutant is unknown at present. Or perhaps a concurrent meteorological study indicates that the sample was collected at a location which cannot be considered representative of the area.

A number of collection techniques have been devised for this purpose. For aerosols, they generally utilize the principles of filtration, electrostatic precipitation, thermal precipitation, or impingement. For gases and vapors, adsorption, absorption, or freeze-out are frequently employed. The complete assembly usually includes a source of vacuum, a device for measuring the quantity of air sampled, and one or more of the above collectors. A timer or programmer may be used. Equipment of this type serves merely as a collector and quantitative analysis must take place in the laboratory. The units have the advantage that by proper combination of collection techniques and analytical procedure they can be made very specific for many polluting materials. Each complete unit may cost a few hundred dollars. Such units, however, are very expensive in time and man power. For an extensive sampling program many man hours may be required in making collections, maintaining the units, and performing the necessary analyses.

To avoid many of these disadvantages, recording instruments have been developed for several of the common pollutants. The ideal instruments, of course, would be a cheap, portable one which would continuously sample, analyze, and record instantaneous variations in the concentration of a pollutant and be specific only for that material over a wide range of concentrations. Not only has the ideal not been attrained, but devices approaching it are few in number. There are several reasons for this scarcity of instrumentation other than purely developmental. There is at present little agreement as to the type of sampling which is required or even desirable for a given situation. For an extensive and continuous program, the available recording instruments may prove to be more economical since the analysis is performed in the unit. It should be borne in mind, however, that the existing instruments are expensive in first cost, many are temperamental in operation, and it may be difficult to eliminate interfering substances.

For many purposes the convenience, precision, and characteristics of the previously described devices are not required. Studies of this type include determinations of the extent of pollution from a source, comparison of pollution in one area with that in another, evaluation of cumulative effects as in materials damage, identification of a source, and locality monitoring. In some instances, depending on the nature of the survey, it may seen desirable to obtain continuously several hundred simultaneous collections. The cost of a program of this type may be prohibitive in view of the cost of individual instruments. If vertical as well as ground-level samples are to be collected, standard samplers may be too heavy, bulky, or inconvenient to use. Practically all sampling programs are thus found to be a compromise between what is desirable and what is economical or convenient.

## SIMPLIFIED TECHNIQUES

An approach which is satisfactory for many purposes is to obtain cumulative indications over a period of time by simplified techniques. No quantitative measure of the concentration of polluting material per unit volume of air can be obtained by such methods but satisfactory information for many purposes may be secured. The unit cost of such techniques is practically insignificant when compared with more elaborate procedures and equipment. These techniques depend for their activity on having the natural movement of the air bring the pollutant in contact with an appropriate reagent. Results of most of these procedures are dependent upon wind velocity, atmospheric moisture, and air temperature. Although in some instances attempts have been made to refine and elaborate upon the basic techniques, much of the benefit may thus be lost. Generally, results obtained by simplified techniques correlate quite well with results obtained by other procedures. Simplified techniques may help to provide preliminary information on which to base decisions concerning an elaborate sampling program, or may be an end in themselves.

## SULPHUR DIOXIDE

Simplified techniques for aerosols, such as fall-out pans and jars, adhesive paper, and greased slides, are very familiar and will not be discussed here. Similar procedures for gases, however, are less familiar. The earliest of the dosimeter methods is applicable to one of the most common air pollutants. This is the lead peroxide candle method for estimating sulphur dioxide. The procedure was developed by Wilsdon and McConneel for work done in England during the early 1930's. It is a cumulative method involving the rate of sulphate formation by exposing lead peroxide paste to sulphur dioxide. The candle which is used consists of a glass form about 14 cm. in circumference. A piece of cotton gauze is applied to the form as reinforcement and the active reagent applied. The active reagent is applied in the form of a thin paste consisting of 8 g. of lead peroxide in about 7 ml. of gum mucilage. The prepared candle, after drying in a desiccator, is ready for exposure. Exposure is in a louvered shelter which protects the reactive surface from rain. After exposure for one month or longer, the candle is removed from the shelter and the area of the reactive surface measured. The coated fabric is stripped from the form by slitting with a razor and the amount of sulphate determined. A similar candle containing the gauze reinforcement, but which has not been exposed, is used as a control. The results of observations are reported as milligrams of sulphate per day per 100 sq. cm. of lead peroxide.

Wilsdon and McConnell indicate that the rate of sulphate formation is proportional to the concentration of sulphur dioxide in the atmosphere, at least up to 15% conversion of the reactive material.

## HYDROGEN SULPHIDE

Sewage treatment plant workers are responsible for another procedure which is useful in air pollution sampling. This involved hydrogen sulphide estimation by the use of lead acetate impregnated papers or tiles. The latter is preferred. Unglazed, white procelain tiles of some convenient size are dipped in the solution, allowed to dry, and exposed in a place where they will be protected from rain. After exposure, the concentration of hydrogen sulphide can be estimated by comparing the exposed tiles with standards. Here again no quantitative estimate can be made but the relative exposure of various localities to hydrogen sulphide can be determined.

## CONCLUSION

These techniques and procedures have been under investiga-

tion in our laboratories and in the field for sometime. We feel they will provide adequate information at minimum cost but they are not yet ready for routine use.

Presented at the meeting of the Gulf Coast Section of TAPPI held in Mobile, Ala., March 13, 1959.

## Dynamic Process Control—When Will We Have It?

*Edward F. Thode*

Dynamic control has been known to mankind since some one of our remote ancestors first tumbled a hollow log into a stream and attempted to guide it through rocks and shoals. Although navigation is at once the most ancient and the most advanced example of dynamic control, it would be unfair to assume that dynamic control of process operations is either new or poorly advanced. The answer to our rhetorical question is necessarily, "We have it right now—but not to the degree that seems possible in the very near future!"

There are two simple principles behind dynamic control—anticipation and compensation. The Piltdown man in his hollow log saw a big rock looming ahead, *anticipated* a collision and a dunking, and *compensated* for the collision-course tendency by poling like mad to one side. In process terms, *anticipation* involves the feedback of information from exit streams combined with forward feed of information (especially from one unit of a complex process to another). The basic methodology of *compensation* involves the manipulation of several input variables and process parameters in concert to accommodate load changes and upsets in uncontrolled variables. If a "bump," or upset, is moving through a multiunit system (such as a stock preparation and papermaking system), the operator may be prepared to deliberately upset some unit along the line in a manner designed to compensate for the first upset and to counteract its effect.

It is well known, for example, that certain strength properties of a paper may be held at a given level by various combinations of refining and wet pressing. If the refining operation is upset, the machine tender can compensate for this by changing the couch vacuum and the nip pressure in the first and second presses. This is done quite commonly today, but often as a result of test information fed back from the dry end, indicating that the paper has gone beyond the control limits. If this compensation is done on the basis of forward feed of information before any off-grade paper is made, then we have true dynamic control.

From the preceding example, one can see that the time factor is of critical importance to successful dynamic process control. Feed-forward of information must be *fast enough* to permit timely compensation, or the primary objective of avoiding off-grade material will not be accomplished. Essentially, it is transients in the process sytem with which we must deal: While these transients are not of the order of microseconds as are the transients in electronics work, still they are fast enough so that the real problem in this type of process control is to see that the flow of information is faster than the flow of material through the process. Oftentimes, this speedy information flow is not a matter of measurement, but rather of conversion or processing of primary date. Good and speedy instrumentation will supply the necessary information in raw data form; but calculations and comparisons with prior norms are required to produce information useful in control action.

Automatic data-processing thus enters the picture not in the sense of a labor-saving function, such as we are familiar with in the business and accounting portions of industrial operations, but in a "messenger" capacity, speeding the flow of information needed for control. For example, if we have a complete chemical and physical characterization of a process (i.e. operating equations) of if we have a great deal of empirical experience with the process (suitably coded for analysis), it is possible to predict—several time constants in the future—what a process will do, based on what it has just done. Thus, we can anticipate the response to upsets, and if this response be unfavorable to process objectives (e.g., quality of product, minimum operating cost, etc.), we can initiate compensating action before any damage can occur. "Damage" in the sense just employed may be as drastic as destruction of equipment and injury to personnel, or as mild (relatively) as production of a little broke.

The preceding statement assumes that we can get enough of the right data fast enough, that we know how to interpret it, and that this interpretation and comparison with experience can likewise be carried out fast enough and accurately enough to permit anticipatory correction. This last consideration provides the opportunity for so-called computer control or computer-assisted control; computers supply the needed speed and accuracy for data processing and comparison where only seconds, or at most, minutes are available.

To retrace the discussion just a bit, however, another prerequisite to fast and effective dynamic control is adequate understanding of the process. With all humility, we must admit that our knowledge of many essential chemical and physical relationships in pulping and papermaking processes is hardly adequate. In some cases, one can treat a control process by the so-called "black-box" technique, determining cause and effect by a statistical analysis of input and output information. If strict causation is established, this may be all that is necessary; but very often spurious relations develop which only get the operator into trouble when an unusual upset occurs. In such case, there is no substitute for fundamental knowledge. Further advances in fundamental knowledge are definitely required before fully effective dynamic control will be possible in some of our processes. On the other hand, the excellent progress our industry is making in acquiring such basic knowledge augurs well for rapid developments in the dynamic control field.

What gains are to be realized from such effort? Surely the avoidance of waste, the ability to maintain closer control limits, the reduction of man-hours per ton of production are all economic gains to be anticipated from extension and development of dynamic control systems. Knowing that paper is one of the major indices of our standard of living, we can be sure that any increase in productivity in the paper industry will be a solid contribution to the real wealth of the entire economy of the United States.

Presented at the meeting of the Gulf Coast Section of TAPPI held in Mobile, Ala., March 13, 1959.

Edward F. Thode, Research Associate, Chemical Engineering Group, The Institute of Paper Chemistry, Appleton, Wis.

## Experiments Using Elemental Sulphur and Total Chemical on Commercial Size Cooks

*H. M. Owen*

A decision to conduct mill trials on cooking with elemental sulphur arose from three basic considerations.

First we seem to have had best over-all operation of our plant through the years on pulps produced with high sulphidity.

As the soda recovery efficiency has increased over the years, the sulphidity maintained by salt cake makeup has dropped below the point desired and some rather expensive and unusual procedures have been used to maintain sulphidity near 25%. We needed to document the effects and the importance of maintaining a given level of sulphidity in our process.

Secondly, we have believed, based on the experience and judgment of the pulp and paper supervisors employed at our plant over the years, that we could maintain relatively high permanganate number and have hard stock while still maintaining low rejects if we kept sulphidity above 25%.

Finally, our system for sulphidity control utilizes only one

H. M. Owen, Gulf States Paper Corp. Tuscaloosa, Ala.

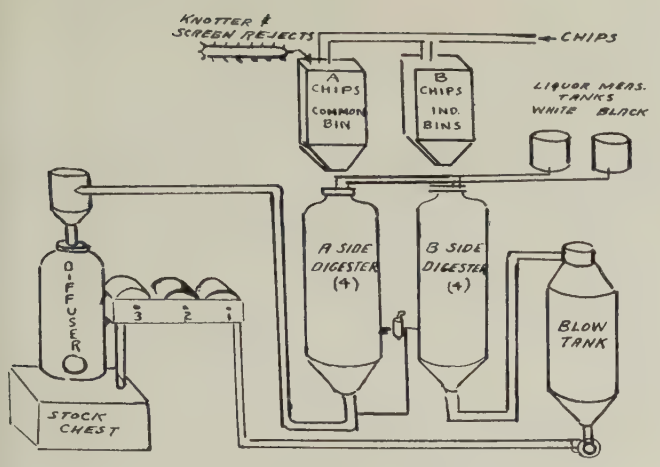
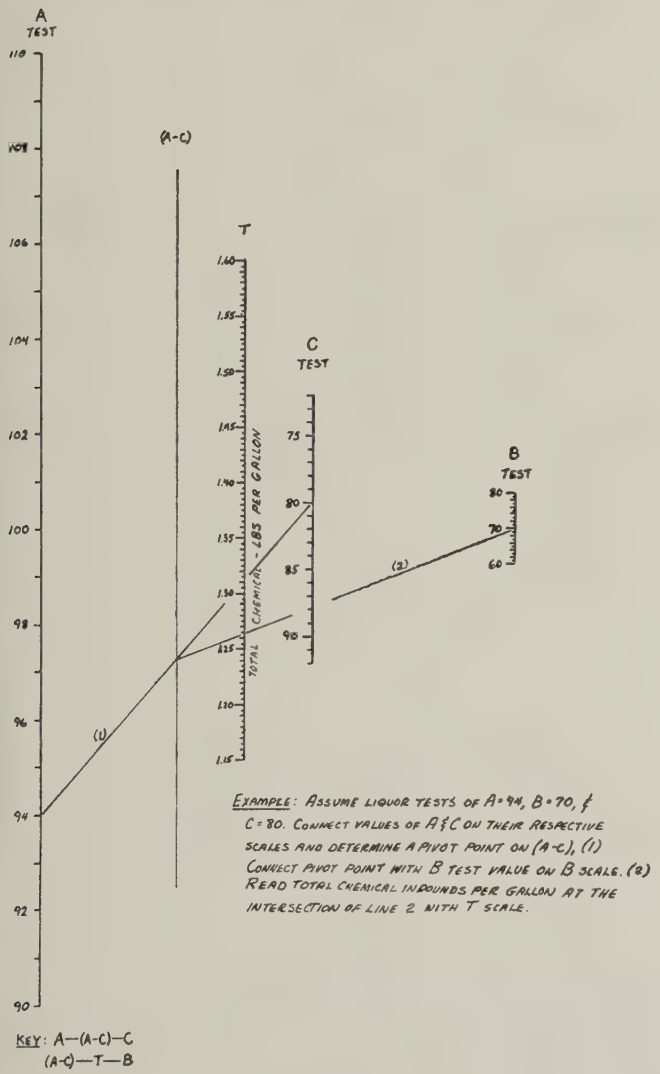



*Fig. 1. Pulping system*

of the two recovery units at the plant for addition of sulphur on the furnace bed and we sometimes have drastic changes in sulphidity when this unit goes down.

***Nomograph for determining white liquor total chemical in pounds per gallon from ABC liquor tests***


A TEST
(A-C)
T
C TEST
B TEST
TOTAL CHEMICAL - LBS PER GALLON
(1)
(2)
EXAMPLE: ASSUME LIQUOR TESTS OF A=94, B=70, & C=80. CONNECT VALUES OF A & C ON THEIR RESPECTIVE SCALES AND DETERMINE A PIVOT POINT ON (A-C), (1) CONNECT PIVOT POINT WITH B TEST VALUE ON B SCALE. (2) READ TOTAL CHEMICAL IN POUNDS PER GALLON AT THE INTERSECTION OF LINE 2 WITH T SCALE.
KEY: A—(A-C)—C
(A-C)—T—B

Sulphur addition: Gallons white liquor × A Test × (% increase desired in sulphidity) × 0.00516 = lb sulphur to be added.

*Example:* A = 100; B = 75; C = 85.

Sulphidity, % = 20% but you want 26% sulphidity, 8200 lb total chemical. Read chart. Gal. W.L. = 6100. ∴ lb sulphur = 6100 × 1.00 × 6 × 0.00516 = 189 lb ≈ 190 Lb. 30 lb sulphur/sack, ∴ 190/30 = 6 sacks.

**Table I**

| *Variable* | *Levels at which controlled* | *Means of control* |
|---|---|---|
| Liquor sulphidity, % | 18–20, 23–25, 28–30 | Addition of sulphur at digester |
| Total chemical per cook, lb. | 6500, 6800, 7200, 7600, 8000 | Metering white liquor on basis of A, B, C tests |
| Total liquor volume, gal. | 7500 | Metering black liquor |
| Quantity of chips per cook | Packed, unpacked | Adding or omitting extra chips after liquor was added |
| Cooking time at full pressure, min. | 60, 80, 100 | Sampling and blowing cooks at prescribed time periods |
| Presence of rejects in chips | Minimum concentration, normal concentration | Opening or closing reject inlet above chip bin |

Even if we could keep sulphidity very level, we know we lose sulphur up the stack and we would also like to run our causticizing operation at low sulphidity for best operation.

We have mixed sulphur with white liquor before going to storage in prior years, but this involves boiling liquor, crushing sulphur, agitation, and other undesirable handling and processing aspects. Since we wished to begin our experimental program on only one of eight digesters, it was felt the use of elemental sulphur in each individual charge requiring sulphidity adjustment offered the most convenient operation.

***Nomograph for calculating the amount of white liquor of known concentration necessary to give a specified total chemical in a cook***

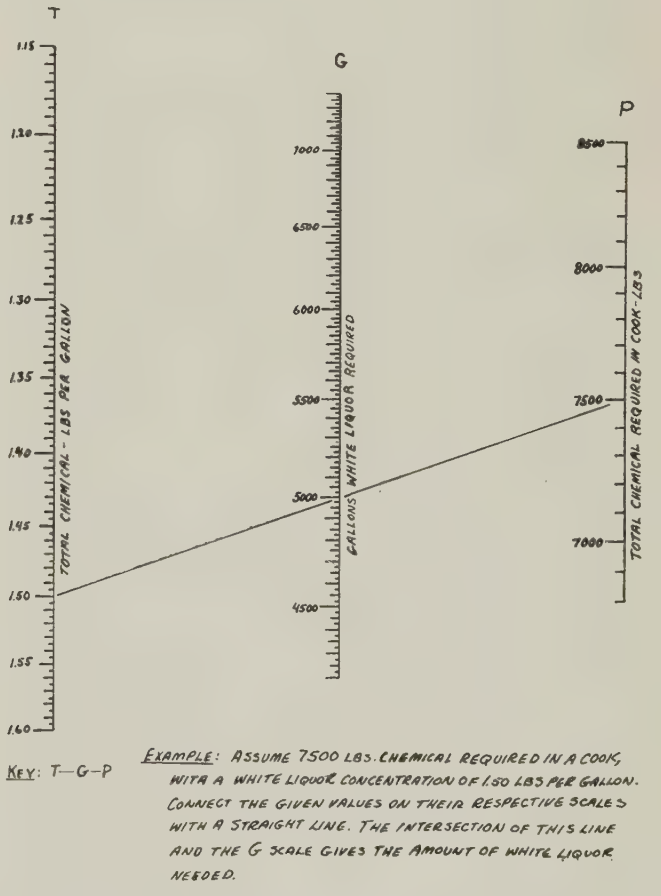

T
G
P
TOTAL CHEMICAL - LBS PER GALLON
GALLONS WHITE LIQUOR REQUIRED
TOTAL CHEMICAL REQUIRED IN COOK - LBS
KEY: T—G—P
EXAMPLE: ASSUME 7500 LBS. CHEMICAL REQUIRED IN A COOK, WITH A WHITE LIQUOR CONCENTRATION OF 1.50 LBS PER GALLON. CONNECT THE GIVEN VALUES ON THEIR RESPECTIVE SCALES WITH A STRAIGHT LINE. THE INTERSECTION OF THIS LINE AND THE G SCALE GIVES THE AMOUNT OF WHITE LIQUOR NEEDED.

*Fig. 2*

The decision to charge cooks on the basis of total chemical came from the consideration of some work done at the University of Alabama paper laboratory as well as some prior work conducted at our plant in the past. It was felt that we should not consider so-called "active alkali" only in charging the cooks.

Considering that the sulphidity was being adjusted and that the ratio of carbonate might vary some over the test period, it was decided to calculate charges on the basis of total chemical.

To appreciate the procedure selected for phasing experimental work an understanding of the pulping systems employed at the plant is helpful.

Figure 1 shows the two pulp lines in our production system. A provision for sampling while cooking and while blowing a cook is available on both units, but only A side allows adequate sampling of a specific cook after blowing and washing.

One digester from the A side that had been equipped for cooking by programed instrumentation was selected for the initial trials in expectation of recording total steam per cook. Later difficulties in equipment operation dictated that we use time rather than total steam as a variable in the experimental project.

In phase I of this project, there were 118 cooks of approximately seven tons per cook.

An outline of the investigation is shown in Table I.

This program was carried out over a period of approximately five weeks.

Personnel from quality service were assigned to each tour to assist with the sampling and data collection.

Prior to the start of actual cooking the supervisors in the pulp mill went over the plans carefully and advised all operators of the purpose and plan of the cooking trials so that a minimum of delay and confusion existed for so great a change in the operation of the digester.

Liquor, chips, and pulp samples were rechecked by personnel familiar with the intent and scope of the operation and we lost very little of the available data through mishandling or poor processing.

Pulps were refined in our laboratory beater on strength tests at 300 ml. Canadian Standard freenesses were used to produce scatter-grams.

The permanganate number and the amount of reject of each cook produced for the tests was determined.

The permanganate number used is not TAPPI Standard, but is about one and one-half numbers lower than TAPPI using 40 ml. of permanganate.

The term reject for the purpose of this test was anything that would not be accepted on a laboratory flat screen equipped with 0.0014-cut plates.

Procedure for loading and cooking was as follows: (1) Load chips. (2) Run ABC tests on white liquor and use nomagraph in Fig. 2 to determine the total pounds of chemical per gallon. (3) Use total pounds of chemical per gallon and total requirement for the cook to determine white liquor to be added. (4) Use formula shown at the bottom of Fig. 2 to determine the amount of sulphur to be added to bring equivalent sulphidity to the desired level and add this amount on top of the chips before adding the white liquor.

The curves shown in Fig. 3 are typical of those produced in the test and will serve to summarize some of the more important results.

The paper tests shown are results of multiple tests made on paper produced in the laboratory by the standard handsheet procedure.

TAPPI tear factor for each sulphidity range versus pounds of total chemical in the cook is represented by a specific color for each range. Cooking time is shown by the curve number, the pattern for all cooks was generally the same with tear tending to peak at 7600 lb. total chemical charge.

Similar representations of TAPPI burst factor and tensile

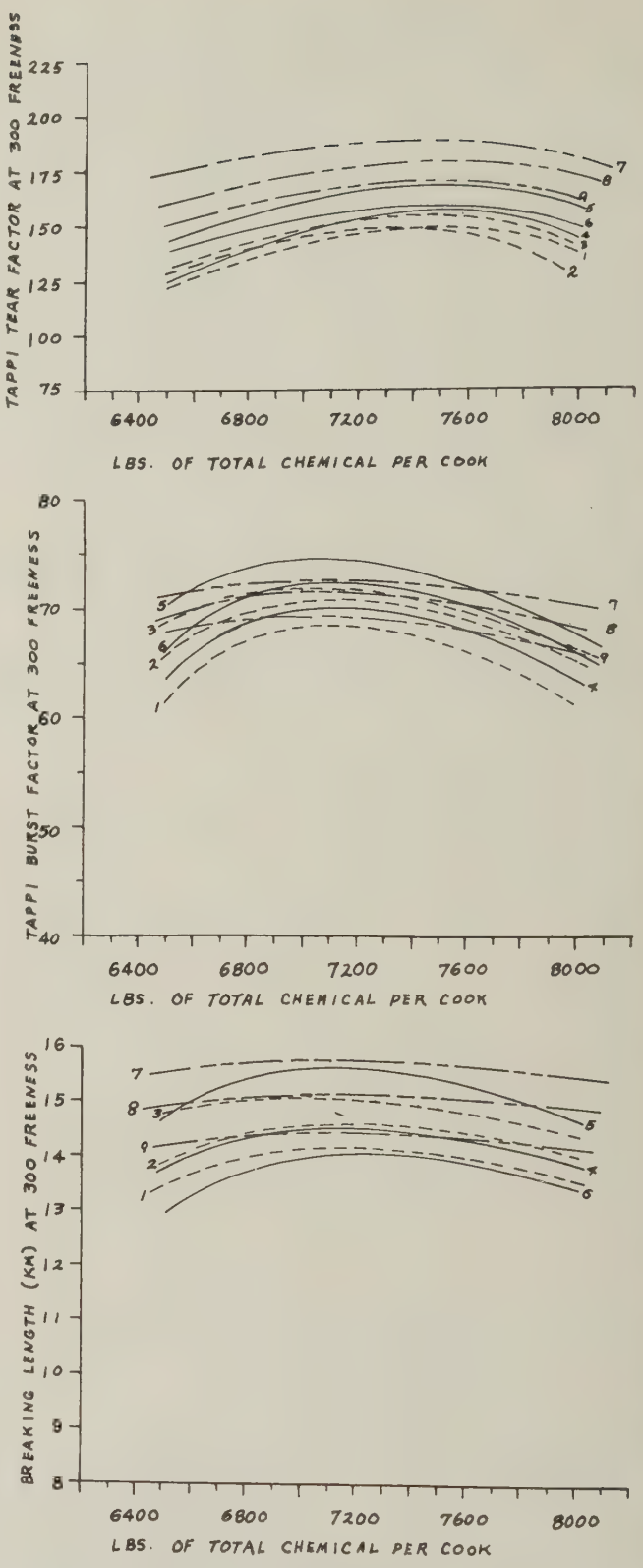



*Fig. 3*

| *Sulphidity, %* | *Cooking Time, Min.* | |
|---|---|---|
| 18–20 | 60 | 1 |
| 18–20 | 80 | 2 |
| 18–20 | 100 | 3 |
| 23–25 | 60 | 4 |
| 23–25 | 100 | 5 |
| 23–25 | 80 | 6 |
| 28–30 | 100 | 7 |
| 28–30 | 80 | 8 |
| 28–30 | 60 | 9 |

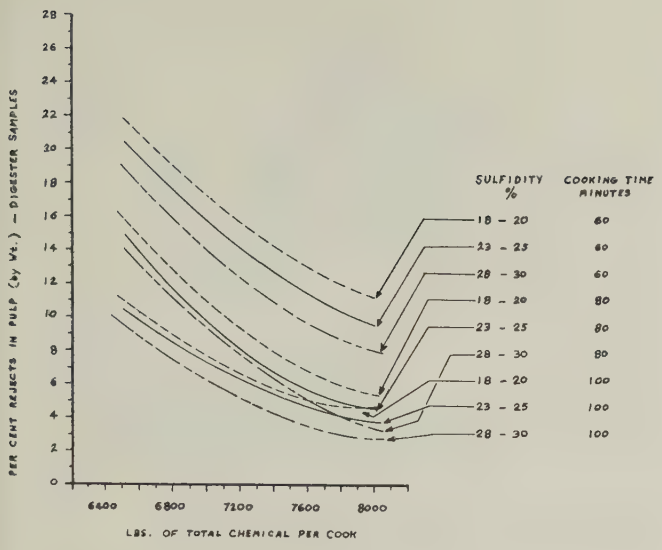

PER CENT REJECTS IN PULP (by Wt.) — DIGESTER SAMPLES
LBS. OF TOTAL CHEMICAL PER COOK
SULFIDITY %
COOKING TIME MINUTES
18 - 20 60
23 - 25 60
28 - 30 60
18 - 20 80
23 - 25 80
28 - 30 80
18 - 20 100
23 - 25 100
28 - 30 100

*Fig. 4*

strength indicate better values in the 7000-lb. total chemical range.

Calculation of total chemical on the cooking charges we have employed over the years range from 6800 to 7300 lb. We have been led to this range in the past by our sensitivity to the mullen test.

Figure 4 displays per cent reject versus pounds of total chemical with sulphidity and cooking time as parameters.

As expected, highest total chemical produced lowest reject. It may also be noted that for a given total chemical and cooking time, the higher sulphidity cooks produced the lower reject valves.

Figure 5 displays permanganate number versus pounds of total chemical with the same arrangement for sulphidity and cooking time as Fig. 4.

Here again it can be seen that higher total chemicals produced lowest permanagate numbers and, further, that for a given charge and cooking time the higher sulphidities produced the lower permanganate numbers.

The fact that rejects and permanagate numbers followed the same trend so closely exploded one of our pet beliefs, namely that low rejects at high permanganate numbers could be produced at high sulphidity.

It may be observed that the slopes of the curves are generally less steep for the high sulphidity cooks at all times, but still the final permanganate number and per cent reject is more dependent on total chemicals and cooking time than on sulphidity.

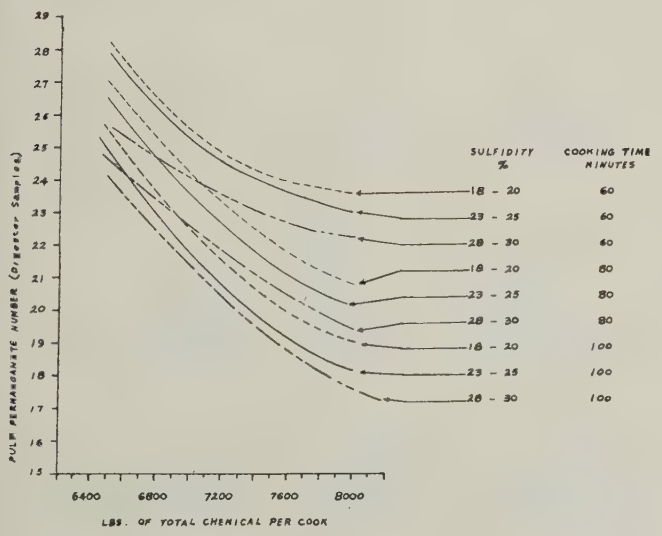

PULP PERMANGANATE NUMBER (Digester Samples)
LBS. OF TOTAL CHEMICAL PER COOK
SULFIDITY %
COOKING TIME MINUTES
18 - 20 60
23 - 25 60
28 - 30 60
18 - 20 80
23 - 25 80
28 - 30 80
18 - 20 100
23 - 25 100
28 - 30 100

*Fig. 5*

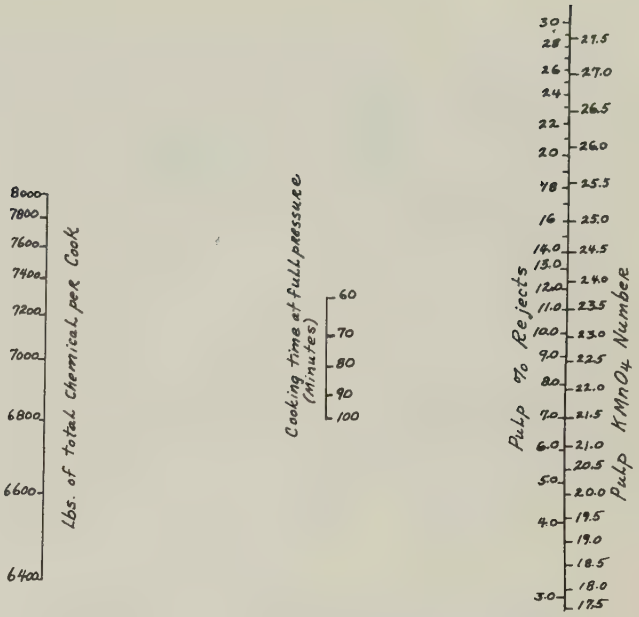



***Fig. 6. Typical nomograph made from no. 3 digester data***

This monograph applies to the following conditions: 28–30% sulphidity. A side digesters—no rejects chips not packed.

From examination of these data, we were able to produce another nomograph, Fig. 6, which allows us to predict permanganate number and per cent reject if we select the total chemical charged and the cooking time to be used at full pressure. These are valid, of course, for fairly narrow ranges of sulphidity only.

Evaluation of the strength properties of the paper made versus total chemical show two things that are significant. There is an improvement in all of the paper tests made on the high sulphidity pulps.

A second series on cooks with chips packed gave the same trends. The most significant increase in test value for experimental pulp was in tear.

A second point to be noted is that the burst and tear maximums occur at different total chemical charges so that one must compromise or select one property to maximize in specifying cooking charge.

Comparisons of the cooks made at constant total chemical with those produced by our normal cooking method using active alkali as the basis for chemical charge indicated that more uniform results in terms of permanganate numbers were obtained with the experimental method.

Based on the results obtained with one digester, a trial on the entire B side employing all four digesters was made. It was decided to recheck or reconfirm our findings relating to better results with high sulphidity and total chemical basis of charge, and it was also decided to pack the chips in order to keep total production up while employing the longer cooking cycle.

Our trials during this second phase were of 4 and 3 days' duration separated by enough time to test and evaluate pulps in order to make any indicated corrections.

The first experimental run employing the entire B side produced strength tests of approximately the same value as our normal cooking procedure but with lower reject and lower permanganate number than values for normal cooks.

A second series of cooks was made in which it was intended to bring the permanganate number back up to normal range by shortening cooking time and thus get our digester cycles back in step with the A side. It was also expected to get better strength in the higher range of permanganate numbers.

The results of comparison of these last special cooks with normal cooks is shown in Fig. 7.

It can be seen from the charts that the permanganate num-

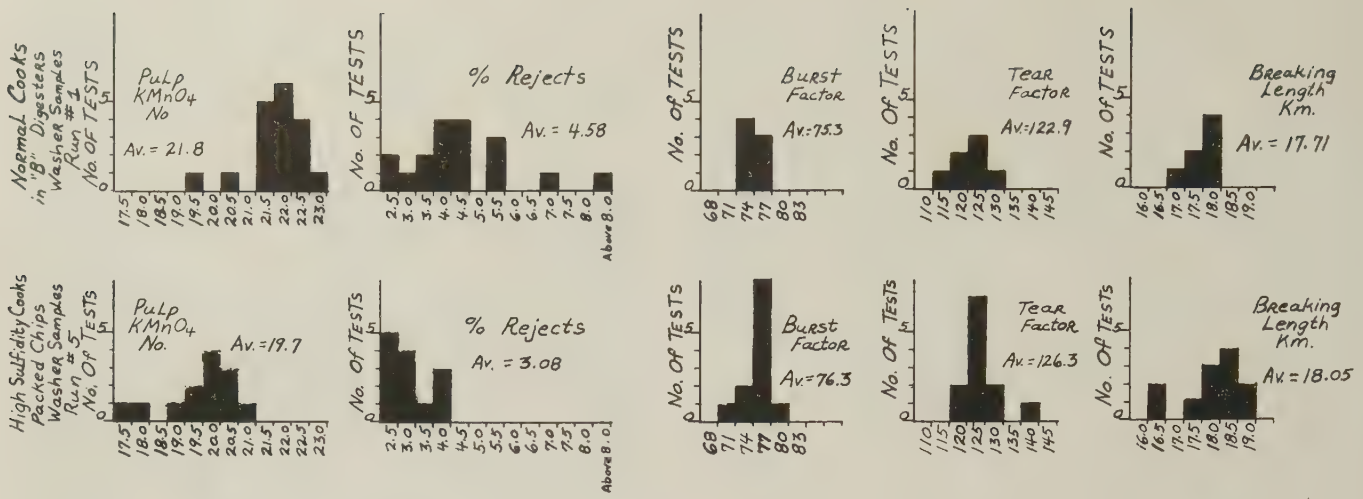



*Fig. 7. Histograms of pulp properties for various cooking methods*

ber was still slightly lower than our normal cooks, the rejects were also lower and the paper strength tests were better.

From the experimental work to date some conclusions have been drawn as follows:

Use of elemental sulphur in digesters is entirely satisfactory as a means of adjusting sulphidity.

No sustainable objections to addition at digesters were found, while at the same time, most of the losses and nuisances involved in adding it to liquor or to furnace were obviated.

Increase in sulphidity (up to 30%) in our process will reduce permanagate number and per cent reject, and will increase pulp strength tests. Thus, at high sulphidity less white liquor is needed to achieve a given permanganate number and per cent reject.

Total chemical basis of charging the digester produces better control of pulp character than does charging on the basis of active alkali.

It is expected that an extended trial leading to complete conversion to the experimental method will be undertaken in the near future. As this work proceeds, it will be followed closely in order that ample statistical confirmation of improved process can be made a matter of record.

More important we expect to increase the reliability of our over-all process by producing pulp of specified and uniform quality.

Presented at the meeting of the Gulf Coast District of TAPPI held in Tuscaloosa, Ala., Jan. 16, 1959.

## Chip Analysis and Classification of Purchased Chips

*Bernard Cox*

In recent years there has been an increasing trend toward use of saw mill chips as a raw material in the paper manufacturing industry. For some mills it is not unusual to receive 20% of their total chip supply from lumber companies utilizing slabs and waste trim. In view of this trend together with the demand for greater pulping efficiency and uniformity, there is an increasing need for adequate procedures in chip sampling and analysis. It is the purpose of this article to present the circumstances encountered and procedures used by Gulf States Paper Corp. to meet this need.

### PAST PROCEDURE

Previous to the summer of 1958, an arbitrary sampling plan was used at Gulf States Paper Corp. whereby one $5^2/_3$-gal. sample of chips was taken at random from each carload of saw mill chips received. For chips made from round logs, one $5^2/_3$-gal. sample was taken from the chip stream during each 8 hr. of chipper operation. The samples were screened individually on a rotating laboratory screen (made by Williams Apparatus Co.) having 3.84 sq. ft. of free screening area. Other pertinent data are as follows:

Nominal chip size, $^5/_8$ in.
Chip moisture range, 42–55%.
Chip screening time, 13 min.

| *Screen position* | *Diameter of openings, in.* | *Distance between openings, in.* |
|---|---|---|
| Top | 1 | $^3/_8$ |
| Second | $^3/_4$ | $^1/_4$ |
| Third | $^1/_2$ | $^3/_{16}$ |
| Fourth | $^5/_{16}$ | $^1/_8$ |
| Fifth | $^3/_{16}$ | $^3/_{32}$ |
| Bottom | Fines tray | |

From the above data it may be noted that TAPPI Standard procedure T 16 m-54 was followed with the exception that screens having $^5/_{16}$ and $^3/_{16}$-in. openings were substituted for screens having $^1/_4$ and $^1/_8$-in. openings.

After determining the weight per cent of chips retained on each screen, the results were sorted according to source and histograms were made plotting average per cent chips retained versus diameter of screen opening. The results are presented in Fig. 1 where sources nos. 1 and 3 represent saw mill chips and source no. 2 represents chips from round legs. Figure 2 shows histograms of number of samples versus per cent chips retained from each sample on various screen openings.

### THE PROBLEM

As indicated by Fig. 1, there is a relatively high percentage of chips retained on the $^1/_2$-in. screen from sources nos. 1 and 3, with diminishing percentages distributed on either side.

Chips from source no. 2 are scattered almost equally on 1, $^3/_4$, and $^1/_2$-in. screens. In seeming contrast, Fig. 2 shows considerable scatter for sources nos. 1 and 3 while source no. 2 has a relatively narrow distribution. On the basis of these results, the following conditions were indicated:

1. Based on the contention that a log chipper in good adjustment tends to produce chips of a dominant size, the log chipper of source no. 2 was consistently out of adjustment (Fig. 2). Bad adjustment part of the time should exhibit considerably more scatter.

2. Either the quality of slab chips from a given source were extremely undependable, or our sampling and screening procedures were considerably inadequate (sources nos. 1 and 3).

With reference to the first condition, a subsequent inspection of the log chipper revealed that it actually was out of adjustment. Appropriate repairs were made.

Bernard Cox, Gulf States Paper Corp., Tuscaloosa, Ala.

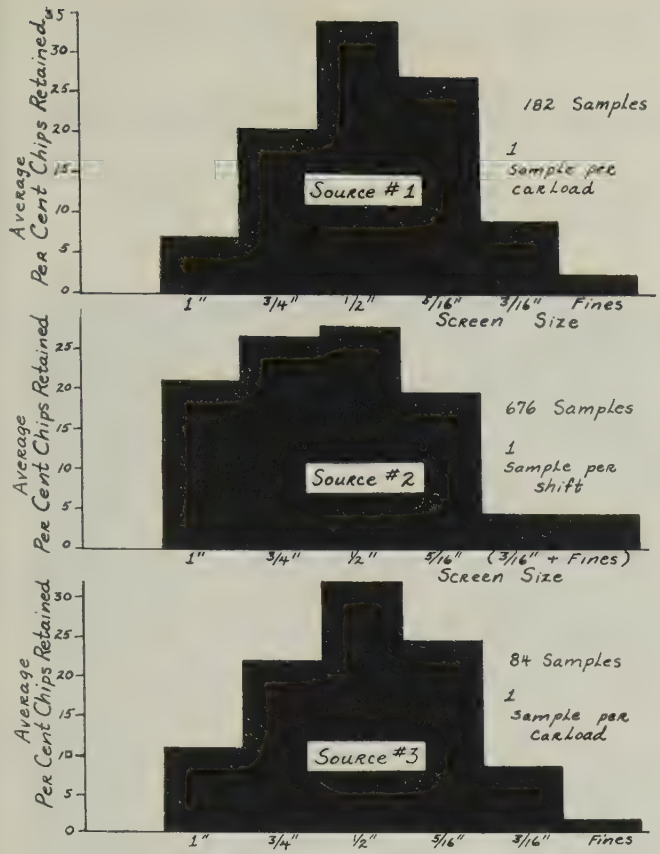



*Fig. 1. Comparison of chips from different suppliers*

With reference to the second condition, personal inspection of slab chips received led to the observation that the variation in chip quality as indicated seemed improbable. At any rate, the extent of this variation could not be determined until an adequate sampling and/or screening procedure was installed. Thus, the basic problem was to determine the most appropriate means of measuring and controlling chip quality.

## METHOD OF SOLUTION

In order to determine whether or not the existing screening procedure was part of the problem, individual 6-gal. samples of chips were screened and weighed and then remixed. After screening and weighing again, it was found that the per cent chips retained on a given size did not differ more than $^1/_2$% between the first and second screening operations. Thus, the

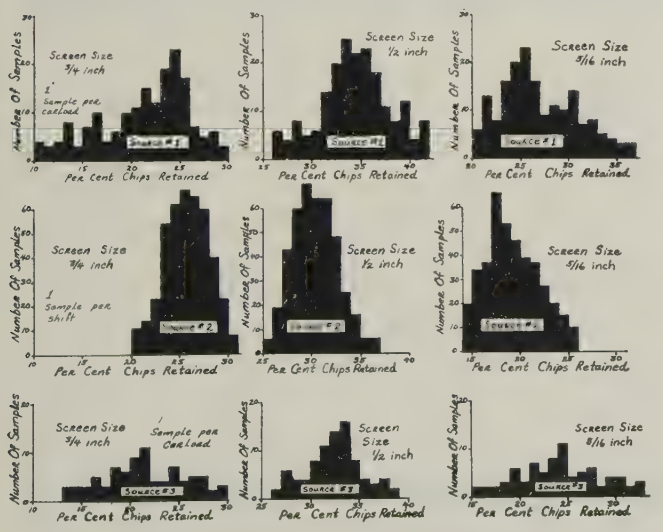



*Fig. 2. Sample distributions from different suppliers*

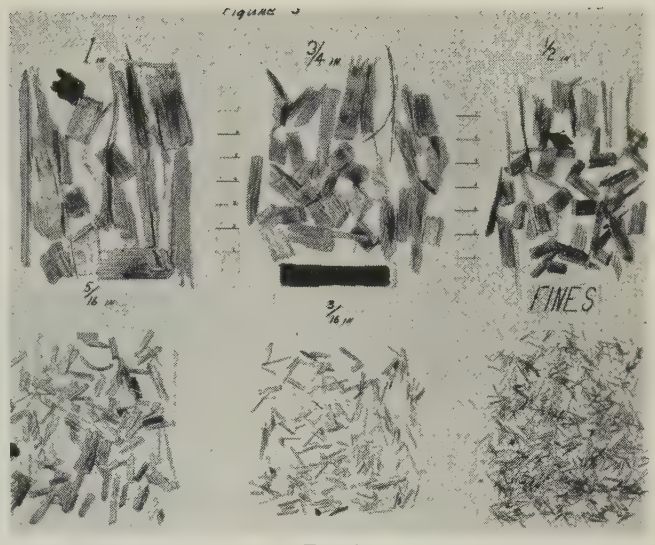



*Fig. 3*

existing screening procedure was not a significant cause of variation in chip quality. An interesting corrolary revealed during this operation is that some chips retained between $^3/_4$ and $^1/_2$-in screens, for instance, measure considerably more than $^3/_4$ in. in their longest dimension. In several cases, slivers 2 to 3 in. long were found on the $^1/_2$-in. screen. An illustration of this is presented in Fig. 3.

Since screening procedure was eliminated as a major cause in chip variation, the remaining problem as to determine an adequate sampling plan for chips received. To determine the extent to which samples from the same population would vary, twenty 6-gal. samples were taken throughout the same carload of chips. After screening the samples individually, his-

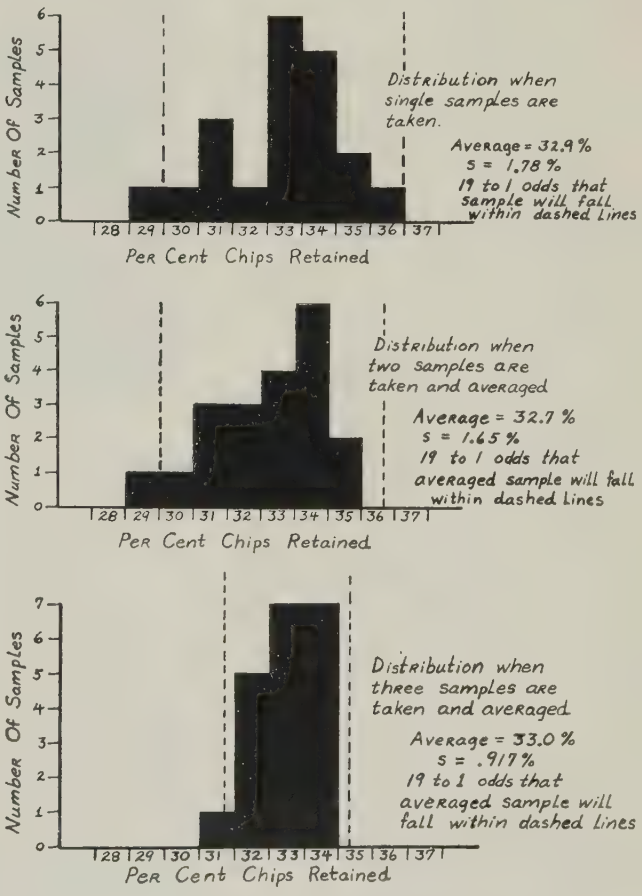

Number Of Samples
Distribution when single samples are taken.
Average = 32.9 %
s = 1.78 %
19 to 1 odds that sample will fall within dashed lines
28 29 30 31 32 33 34 35 36 37
Per Cent Chips Retained
Distribution when two samples are taken and averaged
Average = 32.7 %
s = 1.65 %
19 to 1 odds that averaged sample will fall within dashed lines
Distribution when three samples are taken and averaged
Average = 33.0 %
s = .917 %
19 to 1 odds that averaged sample will fall within dashed lines

*Fig. 4. Comparison of per cent chips retained on $^1/_2$-in. screen by different sampling methods*

tograms were made plotting number of samples versus per cent chips retained on a given size screen. Although any of the screen sizes used may be chosen, the $^1/_2$-in. screen size (presented in Fig. 4) was chosen here because it contained the nominal chip size and was a critical measure of chip quality. As indicated in the top histogram of Fig. 4 there was a variation in chip quality from 29 to 36%, while the average was 32.9%. By taking the standard deviation (1.78%) it was determined that in 19 cases out of 20, no greater accuracy could be obtained than between 29.3 to 36.5% for the same car. To improve this, two samples were taken and then averaged. This was repeated twenty times. The results presented in the middle histogram, showed slight improvement but still were insufficient for control of quality. When three samples were taken and averaged; however (see bottom histogram, Fig. 4) it was determined that in 19 cases out of 20, the results would not vary more than 2% from the actual average of the carload. Using the student $t$ distribution, it would take only 5 carloads of chips to detect (at odds of 19 to 1) a 2% change in chip quality in a supplier's chips. This compares to approximately 35 carloads necessary under the single sampling plan. Although sample variation may be decreased further by taking more than three samples from each carload, the slight improvement obtained is largely cancelled by increased sampling costs. On this basis, the three-sample plan is being installed as standard company procedure. Screening time will be reduced by compositing and quartering the samples.

## CONCLUSIONS

1. Using TAPPI Standard procedure T 16 m-54, it does not necessarily follow that all chips retained between two screen sizes will measure less than the larger screen size in the chips longest dimensions. This creates a possible need in the future for more refined tests in the analysis of chip size.

2. By use of statistics, a sampling plan for measurement and control of chip size was developed.

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Dixon, W. J., and Massey, F. J., Introduction to Statistical Analysis, 1st ed., McGraw-Hill Book Co., Inc., New York, N. Y., 1951.

TAPPI Standard T 16 m-54.

Presented at the meeting of the Gulf Coast District of TAPPI held in Tuscaloosa, Ala., Jan. 16, 1959.

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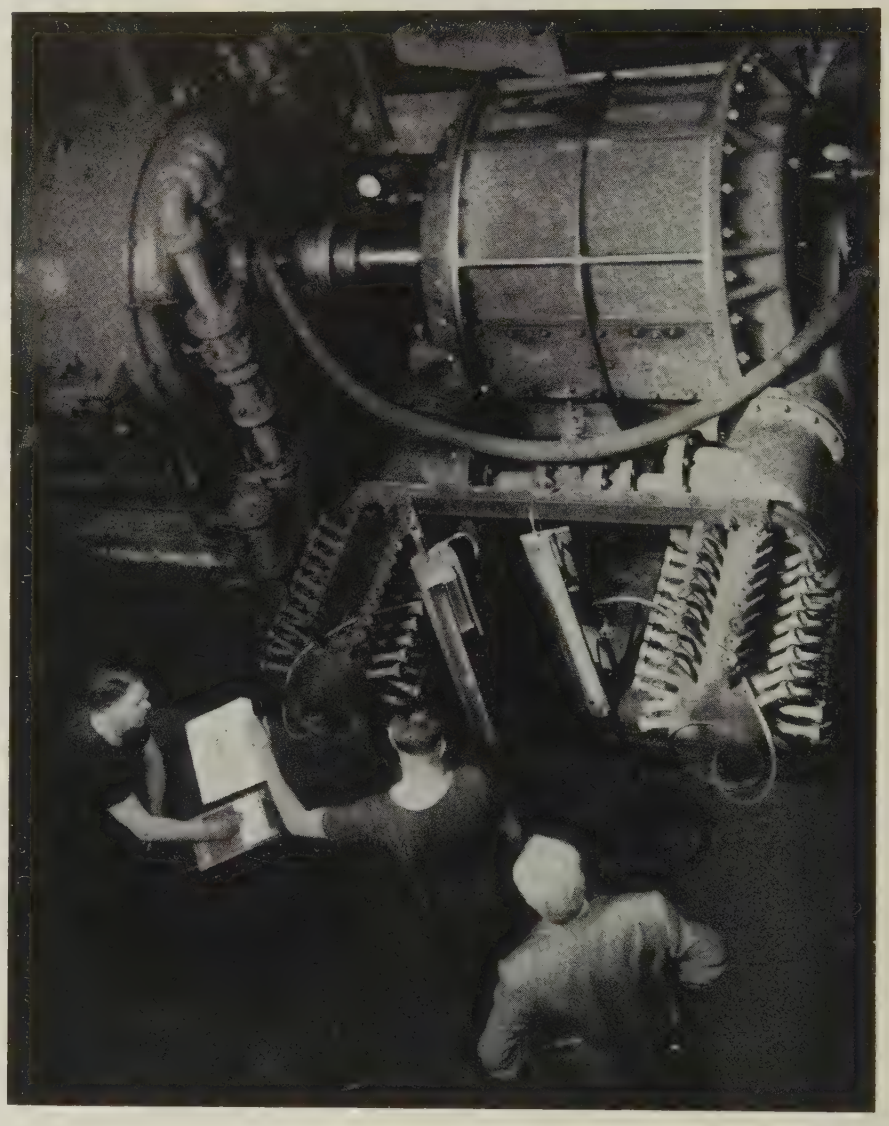

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# UNITED STATES PATENTS ON PAPERMAKING

*Fourth Quarter, 1958* — *Compiled by the Institute of Paper Chemistry*

THE following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired. Or, those desiring the patents on *microcards* should write to The Institute of Paper Chemistry, Appleton, Wis.

**Oct. 7, 1958**

Aull, Watson P. Shoe box having shoe withdrawing means. U. S. patent 2,855,096. Filed April 6, 1956. 7 claims. [Cl. 206-7.]

Bachlott, Donald D. Viscose process. U. S. patent 2,855,321. Filed March 30, 1955. 13 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 106-165.] An improved method is provided for using monoamine additives in producing smooth all-skin rayon filaments.

Bauder, Ulrich, and Hornsteiner, Maximilian. Apparatus for manufacturing heat-sealed flat bags and for pulling such bags over mandrels of square section. U. S. patent 2,854,899. Filed April 16, 1956. 2 claims. Assigned to Firma Fr. Hesser, Maschinenfabrik-A.G. [Cl. 93-8.]

Berry, John C., and Berry, William J. Hosiery package. U. S. patent 2,855,097. Filed June 3, 1957. 8 claims. [Cl. 206-46.] The hose are wrapped about a folded paperboard panel and the assembly is sealed within a cellophane bag.

Cirrito, Anthony J. Method and apparatus for removing air from the stock distribution system of a papermaking machine. U. S. patent 2,854,895. Filed Feb. 8, 1956. 5 claims. Assigned to Rice Barton Corp. [Cl. 92-44.]

Clay, Calvin M. Self-closing bag. U. S. patent 2,855,136. Filed Jan. 27, 1955. 1 claim. Assigned to International Minerals & Chemical Corp. [Cl. 229-62.5.] Improved valve construction is provided in a valve bag.

Dillingham, Frederick L. Machine for debarking slabs. U. S. patent 2,855,011. Filed Oct. 8, 1956. 8 claims. Assigned to Soderhamn Machine Mfg. Co. [Cl. 144-208.]

Duval, Ernest H. Separable twin package. U. S. patent 2,855,135. Filed May 9, 1955. 2 claims. Assigned to Gillette Co. [Cl. 229-27.] This is a paperboard container for two razor blade packs.

Field, Donald E. Thermoplastic compositions and method of making same. U. S. patent 2,855,322. Filed Dec. 9, 1954. 6 claims. Assigned to U. S. Secretary of the Navy. [Cl. 106-186.] Plasticized cellulose caprate is employed as an optical cement.

Gabriel, Arthur E. Composition of matter and method of making the same. U. S. patent 2,855,320. Filed May 5, 1955. 22 claims. Assigned to Carr, Adams & Collier Co. [Cl. 106-163.] This is a lignocellulosic (wood or wood pulp) molding composition.

Griese, Robert W., and Rafoth, Bennie A. Packaging method. U. S. patent 2,854,799. Filed July 31, 1956. 2 claims. Assigned to American Can Co. [Cl. 53-32.] This is a paper-overwrapped paperboard carton for ice cream.

Hamilton, Russel D. Stain and method of application. U. S. patent 2,855,369. Filed Dec. 2, 1955. 1 claim. Assigned to Chadeloid Corp. [Cl. 252-301.3.] Sodium carboxymethylcellulose is used in a wood stain.

Hopkin, John S. Bank deposit envelopes. U. S. patent 2,855,138. Filed May 16, 1956. 1 claim. Assigned to Rockmont Envelope Co. [Cl. 229-72.]

Kleineberg, Paul E., and Roseman, Joseph C. Article counting and collecting machine. U. S. patent 2,854,900. Filed Dec. 13, 1956. 7 claims. Assigned to T. W. & C. B. Sheridan Co. [Cl. 93-93.] Books, magazines, or the like, moving in a continuous path, are counted and stacked.

Kline, Richard E., and Wilson, Joseph W. Pulp treating system. U. S. patent 2,854,894. Filed April 8, 1954. 13 claims. Assigned to Riegel Paper Corp. [Cl. 92-27.] An improved jordan refiner is provided.

Kreibaum, Otto. Method for the production of molded articles. U. S. patent 2,854,696. Filed Nov. 22, 1950. 1 claim. [Cl. 18-47.5.] Warp-resistant wood-particle board is formed.

Leffler, Nils G. Barking machine having centripetally biased scrapers automatically swung to bark-removing positions by an oncoming log. U. S. patent 2,855,010. Filed Oct. 31, 1952. 14 claims. Assigned to Svenska Cellulosa AB. [Cl. 144-208.]

McConnaughay, Kenneth E. Asphaltic paving composition. U. S. patent 2,855,319. Filed Aug. 9, 1954. 8 claims. [Cl. 106-123.] Tall oil is used.

Marton, Koloman. Process for producing shaped articles, particularly plates. U. S. patent 2,854,896. Filed Nov. 18, 1953. 7 claims. Assigned to Rexolit Holzstoffplatten Ges. m. b. H. [Cl. 92-54.] A process for producing pressed board panels is described.

Morton, Henry C. Process for making a friction lining. U. S. patent 2,855,329. Filed Sept. 16, 1955. 3 claims. Assigned to Russell Mfg. Co. [Cl. 117-66.] Asbestos board is impregnated with an organosilicate and a binder to form a friction material for use in auto transmission systems.

Neal, James L., and Dice, Sylvan Y. Flap opening apparatus. U. S. patent 2,855,117. Filed Jan. 25, 1955. 6 claims. Assigned to A-B-C Packaging Machine Corp. [Cl. 214-304.] An apparatus for unloading paperboard cartons filled with cans or bottles is provided with means for opening the case flaps.

Rothenanger, Charles R., Sr. Manufacturer of dry rosin size. U. S. patent 2,855,391. Filed Oct. 12, 1956. 4 claims. Assigned to American Cyanamid Co. [Cl. 260-105.]

Schuster, John H. Carton carrying and cutting implement. U. S. patent 2,854,678. Filed Aug. 27, 1956. 5 claims. [Cl. 7-14.1.] A tool is provided for either carrying or cutting open a paperboard case.

Simonsen, Jens P. Bag with closing strip, a blank of paper, cardboard, or other sheet material for such bags, and a method of manufacturing bags from such blanks. U. S. patent 2,855,137. Filed Jan. 5, 1956. 3 claims. Assigned to Firm of Marius Jacobsen. [Cl. 229-65.]

Thomsen, Alfred M. Regenerating spent cooking liquors produced in making paper pulp. U. S. patent 2,855,272. Filed Nov. 22, 1955. 1 claim. [Cl. 23-63.]

Vogt, Clarence W. Apparatus for and method of combining enwrapments. U. S. patent 2,854,898. Filed May 11, 1953. 8 claims. [Cl. 93-1.] Individual bags are chained together by means of adhesive tape or the like to form a series which can be more easily handled by filling and other machinery than can the single bags.

Watkins, William W. Article of commerce. U. S. patent 2,854,985. Filed April 12, 1954. 6 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 131-10.] This is a cigarette filter formed of cellulose acetate filaments wrapped in a paper tube.

Wells, Roger. Apparatus for molding pulp articles. U. S. patent 2,854,897. Filed Oct. 16, 1956. 9 claims. Assigned to Diamond Gardner Corp. [Cl. 92-57.] The apparatus forms molded pulp plates having several layers of different types of pulp.

Young, Clarence R. Opening devices for signature-gathering machines. U. S. patent 2,855,195. Filed July 1, 1955. 3 claims. Assigned to T. W. & C. B. Sheridan Co. [Cl. 270-54.]

Allemann, Martin. Papermaking machine. U. S. patent 2,855,829. Filed June 22, 1955. 11 claims. Assigned to Sulzer Freres, Societe Anonyme. [Cl. 92-47.] Improved means are provided for lifting the vacuum transfer roll from engagement with the wire.

Brumby, Augusta K., and Mergen, Anne B. Disposable ash receiving receptacle. U. S. patent 2,856,113. Filed Aug. 16, 1955. 5 claims. [Cl. 229-1.5.] A paper-foil laminate forms a combination coaster-ashtray.

Burckhardt, Alfred, and Williams, Bruce E. Workpiece feeding device. U. S. patent 2,856,187. Filed Nov. 18, 1955. 4 claims. Assigned to Pitney-Bowes, Inc. [Cl. 271-26.] The apparatus feeds paper sheets or envelopes in a certain spaced relation.

Burns, Thomas C., and Marvin, William H. Apparatus for coating paper. U. S. patent 2,855,895. Filed Dec. 22, 1954. 3 claims. Assigned to Champion Paper and Fibre Co. [Cl. 118-407.]

Crittenden, Charles B. Sheet feeding mechanism. U. S. patent 2,856,188. Filed July 12, 1956. 8 claims. Assigned to Harris-Intertype Corp. [Cl. 271-53.] Printing press feed rolls are designed to prevent their damaging paper sheets when they move into contact therewith.

Duke, Edward T. Coated cut-off saw for asbestos articles. U. S. patent 2,855,669. Filed April 28, 1954. 2 claims. Assigned to Nicolet Industries, Inc. [Cl. 20-350.] The cut-off saw is for use on asbestos or paper tubing.

Einhiple, John A. Continuous web perforating machine. U. S. patent 2,855,998. Filed April 12, 1955. 2 claims. Assigned to National Gypsum Co. [Cl. 164-90.] The apparatus perforates gypsum board while it is still wet from the forming machine.

Fanning, Frank U. Abrasive rolls. U. S. patent 2,855,732. Filed April 29, 1958. 8 claims. Assigned to Lectro Mfg., Inc. [Cl. 51-190.] An improved bonding method is provided in the manufacture of abrasive rolls formed by convolutely winding a sheet of abrasive material.

Felber, John. Carrying device for containers. U. S. patent 2,856,069. Filed Nov. 9, 1955. 1 claim. Assigned to American Can Co. [Cl. 206-65.] A string tie device joins two flat-top paperboard milk cartons to form a unitized handled merchandising pack.

Fisher, James W., and Bates, Harold. Process for making cellulose acetate of low acetyl value by heterogeneous ripening. U. S. patent 2,856,401. Filed July 22, 1955. 6 claims. Assigned to British Celanese Ltd. [Cl. 260-230.]

Fredrickson, Ralph E. C. Dextrin starch paste and process of making it. U. S. patent 2,856,307. Filed Jan. 12, 1955. 4 claims. Assigned to A. E. Staley Mfg. Co. [Cl. 106-208.]

Gordon, Jack C. Indented resilient matted fibrous pad. U. S. patent 2,856,323. Filed Nov. 9, 1955. 6 claims. [Cl. 154-49.] Paper or the like is coated with a bonding agent and mechanically deformed to provide a product of use in interior packing, insulation, and other uses.

Graves, John B. Tree girdling tool. U. S. patent 2,855,724. Filed Sept. 19, 1957. 3 claims. [Cl. 47-1.]

Groth, Fred A. Packaging process. U. S. patent 2,855,735. Filed May 2, 1955. 10 claims. Assigned to Skin-Pack, Inc. [Cl. 53-22.] A method of skin-packaging articles against a paperboard backing card is described.

Guyer, Reynolds. Cartons for frozen foods. U. S. patent 2,856,114. Filed March 7, 1955. 6 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-14.] A cellophane liner is designed so that it does not interfere with the closing of the usual hinged self-locking lid.

Haliczer, Marcus. Accordion-folded face mask. U. S. reissue patent 24,549. Filed June 30, 1958. 6 claims. [Cl. 128-141.] The mask is of tissue paper.

Howsam, Hilyard C. Disposable reel. U. S. patent 2,856,137. Filed April 16, 1956. 2 claims. [Cl. 242-118.7.] Spiral-wound kraft paper on a steel frame forms the hub and fiberboard panels, the heads of a reel for packaging wire.

Jacknin, Bernard. Filter tip. U. S. patent 2,855,937. Filed Jan. 12, 1955. 2 claims. Assigned to American Machine & Foundry Co. [Cl. 131-10.] The filter is formed from paper flock-coated with fibers.

Jacobsen, Paul W. Mechanical cut-off for tear strip applicator. U. S. patent 2,855,995. Filed May 12, 1954. 5 claims. Assigned to H. G. Weber and Co., Inc. [Cl. 164-42.] This is an apparatus for applying pressure-sensitive tear tape to a carton blank.

Johnson, Nancy H., and Coney, Charles H. Cellulosic coatings for vinyl copolymers. U. S. patent 2,856,306. Filed March 4, 1957. 5 claims. Assigned to Eastman Kodak Co. [Cl. 106-184.]

Kanter, Harry. Support means for displaying neckwear or the like. U. S. patent 2,855,649. Filed May 2, 1956. 2 claims. [Cl. 24-84.] This is a paperboard device with integral hanger-hook means.

Kirk, George B. Cementitious compositions and method of making the same. U. S. patent 2,856,304. Filed Dec. 28, 1953. 14 claims. Assigned to Kaiser Gypsum Co., Inc. [Cl. 106-111.] Alkali lignin or lignosulphonates are included in the gypsum composition for use in making gypsum board.

Kuder, Theodore L., and Reaves, Richard W. Flexible hard surface floor and wall coverings and process therefore. U. S. patent 2,856,315. Filed Aug. 4, 1954. 19 claims. Assigned to Congoleum-Nairn Inc. [Cl. 117-76.] A synthetic rubber-mineral filler layer is interposed between the impregnated felt backing and the seal coat.

Lehmann, Rolf. Apparatus for automatically collating sheets of paper and the like. U. S. patent 2,856,183. Filed April 25, 1955. 13 claims. [Cl. 270-58.]

Magill, Donald G. Method of making scored container bodies. U. S. patent 2,855,884. Filed June 27, 1955. 3 claims. Assigned to American Can Co. [Cl. 113-120.] A metal-end paperboard can for use in packaging ready-to-bake biscuits is formed.

Malm, Carl J., and Crane, Carlton L. Method for the manufacture of low viscosity cellulose acetate dicarboxylates. U. S. patent 2,856,400. Filed Jan. 30, 1957. 7 claims. Assigned to Eastman Kodak Co. [Cl. 260-225.]

Mench, John W., Fulkerson, Brazelton, and Lapham, George B. Method of preparing dicarboxylic acid esters of the lower fatty acid esters and the ethers of cellulose containing free and esterifiable hydroxyl groups. U. S. patent 2,856,399. Filed Feb. 11, 1957. 7 claims. Assigned to Eastman Kodak Co. [Cl. 260-224.]

Mengis, Albin J. Apparatus for making bags. U. S. patent 2,855,832. Filed Jan. 13, 1954. 1 claim. Assigned to W. Inc. [Cl. 93-19.] An improved sequence of steps is provided in a bag-making operation which includes the application of paper patches to a web of bag-forming material.

Nichols, Gordon E. Desk calendar mount. U. S. patent 855,708. Filed April 19, 1955. 1 claim. Assigned to Winthrop-Atkins Co., Inc. [Cl. 40-120.]

Noland, Joseph T., Jr., and De Franco, Victor R. Machine for loading articles into cartons. U. S. patent 2,855,740. Filed Dec. 7, 1956. 3 claims. Assigned to New England Tomato Co. [Cl. 53-250.]

Novak, Leo J. Pressure sensitive adhesive article containing dextran. U. S. patent 2,855,925. Filed Jan. 12, 1954. 14 claims. Assigned to Commonwealth Engineering Co. of Ohio. [Cl. 128-156.]

O'Brien, John E. Multiform envelopes. U. S. patent 2,856,115. Filed Aug. 11, 1955. 11 claims. [Cl. 229-92.1.]

Ottinger, August F., and Stetson, Bradford R. Bad closure. U. S. patent 2,855,881. Filed Jan. 20, 1956. 2 claims. Assigned to Bemis Bro. Bag Co. [Cl. 112-262.] A nylon-rayon thread is used to stitch the closure of a multi-ply paper bag.

Paige, Richard E. Shipping and display carton. U. S. patent 2,856,068. Filed March 21, 1955. 5 claims. Assigned 50% to General Electric Co. and 50% to Richard E. Paige, Inc. [Cl. 206-45.14.] This is a tubular four-sided carton open front and back for displaying electrical switches and the like.

Rowland, Clare B. Paper folding machines. U. S. patent 2,855,830. Filed Feb. 1, 1956. 9 claims. Assigned to General Motors Corp. [Cl. 93-1.] A pleated paper product is formed for use in oil filter units.

Rugg, Gordon S., and Kubick, Harry A. Sorter finger stacker. U. S. patent 2,855,833. Filed Sept. 28, 1956. 12 claims. Assigned to Eastman Kodak Co. [Cl. 93-93.] A machine for severing webs of paper into sheets is provided with means to stack the sheets in groups of predetermined number.

Schoenwolf, Friederich W. Coin wrapping apparatus. U. S. patent 2,855,739. Filed Nov. 3, 1955. 10 claims. Assigned to Automatic Coin Wrapping Machine Corp. [Cl. 53-212.]

Schultz, William C. Web feeding and cutting mechanism. U. S. patent 2,855,997. Filed April 19, 1955. 7 claims. Assigned to West Virginia Pulp and Paper Co. [Cl. 164-68.] A flying cutter is designed to cut several webs at once, with the superposed sheets produced being the same size.

Shaw, Hugh H., Sanderson, Martin I., and Bradshaw, Harold. Carton closing machines. U. S. patent 2,855,741. Filed May 9, 1955. 7 claims. Assigned to Cochran Motors. [Cl. 53-374.]

Shepp, Robert O. Portable control cable with crepe paper separator. U. S. patent 2,856,453. Filed May 25, 1954. 2 claims. Assigned to General Electric Co. [Cl. 174-116.]

Shields, Donald J., Kibler, Charles J., and Schulken, Roger M., Jr. Cellulose ester plastics in attenuated form containing poly-(4-acetyl-beta-resorcylic acid) as an ultraviolet inhibitor. U. S. patent 2,856,305. Filed Feb. 18, 1957. 5 claims. Assigned to Eastman Kodak Co. [Cl. 106-180.]

Sparks, George C. Packaging devices. U. S. patent 2,856,067. Filed Feb. 27, 1956. 7 claims. [Cl. 206-43.] A paperboard traylike device, set up from a single blank, is provided for use in packaging a number of hypodermic needles.

Stelzer, Carl. Mechanism for wrapping assembled cigarette cartridges or cigarettes and filter mouthpieces. U. S. patent 2,855,938. Filed March 23, 1955. 1 claim. Assigned to Kurt Köber & Co., K.-G. [Cl. 131-94.]

Stewart, Bruce D. Inlay and tipping machine. U. S. patent 2,855,844. Filed March 25, 1955. 5 claims. Assigned to McKiernan-Terry Corp. [Cl. 101-23.] An improved embossing calendar is described.

Stobb, Anton R. Conveyor for flexible sheets. U. S. patent 2,855,996. Filed March 16, 1955. 9 claims. Assigned to Western Printing & Lithographing Co. [Cl. 164-68.] This is a web-sheeting and delivery mechanism for a web-fed printing press.

Stobb, Anton R. Flexible sheet folding machine and method. U. S. patent 2,856,184. Filed Dec. 20, 1954. 9 claims. [Cl. 270-73.]

Turner, Harry W. Treatment of cotton linters. U. S. patent 2,856,402. Filed Sept. 26, 1955. 13 claims. Assigned to Hercules Powder Co. [Cl. 260-231.] The fibers are etherified to improve the strength of paper made therefrom.

Wagner, Edward E. Rotatable heat sealer. U. S. patent 2,855,977. Filed July 11, 1955. 14 claims. [Cl. 154-42.]

Various improvements are made in a machine for wrapping cigarette packs in a cellophane wrapper.

Weiss, Walter J., and Graves, Richard H. Drilling method. U. S. patent 2,856,154. Filed Feb. 27, 1957. 3 claims. Assigned to Texas Co. [Cl. 255-1.8.] Lignins derived from spent sulphite liquor and from hemlock bark are used.

Weiss, Walter J., and Hall, Wilbur L. Drilling fluid. U. S. patent 2,856,355. Filed July 25, 1956. 17 claims. Assigned to Texas Co. [Cl. 252-8.5.] This is similar to U. S. patent 2,856,357 (Oct. 14, 1958).

Weiss, Walter J., and Hall, Wilbur, L. Drilling fluid. U. S. patent 2,856,357. Filed July 25, 1956. 16 claims. Assigned to Texas Co. [Cl. 252-8.5.] Lignosulphonates, alkali lignin, and hemlock bark additives are employed as drilling fluid additives.

Weiss, Walter J., and Hall, Wilbur L. Preparation of a drilling fluid composition and method of use. U. S. patent 2,856,356. Filed July 25, 1956. 15 claims. Assigned to Texas Co. [Cl. 252-8.5.] This is similar to U. S. patent 2,856,357 (Oct. 14, 1958).

Whipple, John E. Fiber disk filter cartridges. U. S. patent 2,856,076. Filed March 30, 1956. 1 claim. Assigned to Fram Corp. [Cl. 210-352.] This is a diesel engine oil filter comprising primarily a stack of filter paper disks.

Winkler, Richard, and Dünnebier, Kurt. Methods of and apparatus for stacking envelopes and like articles. U. S. patent 2,856,189. Filed Oct. 12, 1955. 12 claims. Assigned to Berkley Machine Co. [Cl. 271-69.]

Wooding, William M., Jen, Yun, and Sheers, Edward H. Cellulose film containing modified melamine-formaldehyde resin as anchor medium. U. S. patent 2,856,314. Filed Dec. 21, 1956. 6 claims. Assigned to American Cyanamid Co. [Cl. 117-71.]

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Albrecht, Philipp, and Pelikan, Franz. Method to produce adhesive. U. S. patent 2,857,288. Filed May 10, 1955. 9 claims. [Cl. 106-123.] Lignosulphonates are included in a linoleum adhesive.

Beachler, Edward D. Cylinder paper machine assembly. U. S. patent 2,856,825. Filed March 16, 1956. 8 claims. Assigned to Beloit Iron Works. [Cl. 92-43.] Means are provided to deaerate the white water before it is recirculated.

Beckman, George, and Robert, John. Metallic surfaced insulating structural materials for siding and roofing. U. S. patent 2,856,647. Filed April 15, 1954. 2 claims. Assigned to Globe Siding Products Co. [Cl. 20-5.] The structure includes corrugated aluminum sheeting affixed to asphalt insulating board.

Bikales, Norbert M. Method for the cyanoethylation of cotton textile fibers. U. S. patent 2,857,239. Filed June 30, 1955. 2 claims. Assigned to American Cyanamid Co. [Cl. 8-120.]

Bowman, Wade V., and Houck, Frank H. Hosiery form inserting apparatus and method. U. S. patent 2,857,085. Filed April 5, 1955. 15 claims. Assigned to Wade V. Bowman. [Cl. 223-1.]

Burton, Leonard, and Spear, Allan I. Decorative laminates. U. S. patent 2,857,302. Filed Feb. 16, 1956. 4 claims. Assigned to National Plastic Products Co. [Cl. 154-45.9.] The laminates are rendered nonwarping by including in the lower portion of the core assembly a sheet of double-creped kraft.

Carroll, James H. Rubber-rosin-asphalt compositions and their preparation. U. S. patent 2,857,351. Filed June 14, 1954. 10 claims. Assigned to Phillips Petroleum Co. [Cl. 260-27.] The addition of rosin acids renders the particulate composition free-flowing.

Clark, Bryce L., and Miller, Carl S. Heat-sensitive copying-paper. U. S. reissue patent 24,554. Filed April 30, 1957. 19 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl. 117-36.] This is similar to U. S. patent 2,859,351 (Nov. 4, 1958).

Edelson, Dorothy R. Means for facilitating lifting layered sheet material. U. S. patent 2,857,047. Filed Oct. 22, 1956. 2 claims. [Cl. 206-58.] A paper strip is wound between layers of a plastic film which is packaged in roll form in a dispensing carton.

Enzie, William H. Strip-faced case. U. S. patent 2,857,091. Filed Nov. 23, 1956. 2 claims. Assigned to General Foods Corp. [Cl. 229-37.] In forming a corrugated shipping container, the liner portion of the board is eliminated from the greater part of the interior of the carton.

Etherington, Lewis D., Newberg, Raymond G., Wilson, Howard L., and Sayko, Andrew F. Process for the production of polyethylene-wax blends. U. S. patent 2,857,352. Filed May 15, 1953. 4 claims. Assigned to Esso Research and Engineering Co. [Cl. 260-28.5.] The nonblocking high sealing strength compositions prepared are of use in application to paper.

Fallert, Clifford D. Container for heavy articles. U. S. patent 2,857,090. Filed June 2, 1955. 1 claim. Assigned to Crown Zellerbach Corp. [Cl. 229-36.] A flat heavy-duty paperboard container is provided for use in packaging welding rods and like heavy goods.

Fleming, Margaret E. Dental cleaners. U. S. patent 2,856,938. Filed Oct. 8, 1954. 2 claims. Assigned to John Stuart Fleming. [Cl. 132-93.] This is similar to U. S. patent 2,856,939 (Oct. 21, 1958).

Fleming, Margaret E. Dental cleaners. U. S. patent 2,856,939. Filed Jan. 13, 1956. 4 claims. Assigned to John Stuart Fleming. [Cl. 132-93.] The cleaner is formed of a strip of thin flexible sized wet-strength paper having a soft cushioned edge.

Foote, Daniel J., and Kailas, William G. Display cartons. U. S. patent 2,857,045. Filed March 19, 1957. 4 claims. Assigned to Master Lock Co. [Cl. 206-46.] This carton is designed to display a padlock.

Griffith, Thomas R., and MacGregor, Donald W. Method of using lignin for introducing water into vulcanizable compositions. U. S. patent 2,857,345. Filed Oct. 1, 1953. 3 claims. Assigned to Howard Smith Paper Mills Ltd. [Cl. 260-17.5.]

Hales, Ralph A., and Varland, Robert H. Purification of beta-glucose pentaacetate. U. S. patent 2,857,378. Filed May 15, 1956. 6 claims. Assigned to Atlas Powder Co. [Cl. 260-234.]

Harris, Richard W. Packing machinery. U. S. patent 2,856,827. Filed Jan. 30, 1956. 7 claims. Assigned to Molins Machine Co., Ltd. [Cl. 93-49.] The machine forms a small hinged-lid box, apparently similar to a flip-top cigarette box.

Hartman, Newton H. Methods and apparatus for handling bags. U. S. patent 2,856,741. Filed Aug. 3, 1955. 10 claims. Assigned to Knoxville Fertilizer Co. [Cl. 53-124.] Filled paper bags are supported, conveyed, and positioned for stitching.

Hollingsworth, Clinton A., Schilling, Karl F., and Wester, Jordan L. Flotation reagent. U. S. patent 2,857,331. Filed Dec. 12, 1955. 15 claims. Assigned to Smith-Douglass Co., Inc. [Cl. 252-61.] A tall oil derivative is used in an ore beneficiation process.

Johnson, Olaf. Self-locking carrier for cans or like containers. U. S. patent 2,857,048. Filed April 19, 1957. 5 claims. Assigned to Fibreboard Paper Products Corp. [Cl. 206-65.]

Kampf, Leo. Mortar and light-weight concrete composition. U. S. patent 2,857,287. Filed Dec. 30, 1954. 12 claims. [Cl. 106-109.] Methylcellulose is used.

Keil, Henry P. Feed tray for duplicating machines. U. S patent 2,857,159. Filed Dec. 31, 1951. 11 claims. Assigned to Fixture Hardware Corp. [Cl. 271-61.]

Kist, Karl E. Sheet feeder. U. S. patent 2,857,161. Filed Aug. 16, 1956. 10 claims. Assigned to Harris-Intertype Corp. [Cl. 271-48.]

Klein, Walter A. Dispensing containers for sheet wrapping material. U. S. patent 2,857,046. Filed May 31, 1956. 2 claims. Assigned to Dow Chemical Co. [Cl. 206-58.] A dispensing carton for a roll of waxed paper and the like is provided with means to prevent web recoil.

Mauthe, Gustav, and Fingado, Rudolf. Synthetic resin tanning agents containing alkali pretreated sulphite waste liquor and process of preparing same. U. S. patent 2,857,346. Filed Jan. 21, 1955. 16 claims. Assigned to Farbenfabriken Bayer A. G. [Cl. 260-17.5.]

Norquist, Harry H., and Gilbert, Harry A. Machine and method for forming disposable paper pallets. U. S. patent 2,856,826. Filed April 19, 1957. 47 claims. Assigned to Martinson Machine Co. [Cl. 93-1.]

Orsini, Leon F. Treatment of paper. U. S. patent 2,857,291. Filed Feb. 28, 1956. 10 claims. Assigned to Societe des Usines Chimiques Rhone-Poulenc. [Cl. 117-76.] Wallpaper is rendered resistant to water and marking.

Philips, Herman G., Jr. Water-insoluble ethyl cellulose and plasticizer anhydrous aerosol hair lacquer. U. S. patent 2,857,314. Filed June 7, 1954. 8 claims. Assigned to Hercules Powder Co. [Cl. 167-87.1.]

Roche, John C., and Castner, John F. Packaging tray. U. S. patent 2,857,089. Filed March 17, 1955. 2 claims. Assigned to Chicago Carton Co. [Cl. 229-30.] An open-top partitioned paperboard tray is provided for use in packaging cookies and similar bakery products.

Sundberg, Robert L. Process of preparing ester and amide type anionic surface active agents. U. S. patent 2,857,370. Filed Nov. 22, 1954. 6 claims. Assigned to General Aniline & Film Corp. [Cl. 260-97.5.] These agents have various papermaking uses, such as inhibiting foaming during beating.

Thompson, Archibald W., and Freeborn, Albert S. Electric cable and condenser insulation including Fischer-Ttropsch wax. U. S. patent 2,857,350. Filed June 1, 1953. 7 claims. Assigned to Dussek Brothers & Co., Ltd. [Cl. 260-27.] A composition is provided for impregnating cable-insulating paper.

Tolbert, Ralph D., Jr., Bacino, Joseph E., and Lundquist, Hajlmar T. Container. U. S. patent 2,857,076. Filed Nov. 8, 1956. 5 claims. Assigned to National Vulcanized Fibre Co. [Cl. 220-67.] An improved joint is provided between the cylindrical side wall and the top and bottom reinforcing rims of a container designed for use as a trash basket or the like.

Vandeman, Jack E. Sheet feeder. U. S. patent 2,857,160. Filed Aug. 16, 1956. 9 claims. Assigned to Harris-Intertype Corp. [Cl. 271-48.]

von Gaa, Karl H. Folding paperboard carrier. U. S. patent 2,857,077. Filed June 18, 1956. 4 claims. Assigned to Continental Can Co., Inc. [Cl. 220-103.] A bottle carrier includes an integral coupon flap.

Wagenfeld, Gilbert B. Adjustable headpiece. U. S. patent 2,856,608. Filed June 11, 1956. 3 claims. [Cl. 2-197.] A lunch-counter type paper cap is provided.

Walus, Aloysius N. Coating compositions comprising an oil modified alkyd resin and nitrocellulose. U. S. patent 2,857,344. Filed Nov. 26, 1956. 7 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-16.]

Williams, Alford A. Paperboard carton. U. S. patent 2,857,088. Filed Dec. 2, 1955. 10 claims. Assigned 50% to Stone Container Corp. and 50% to Old Dominion Box Co., Inc. [Cl. 229-16.] A collapsible hinged-lid carton is provided with reinforced panels and self-locking means.

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Archer, Edward M. Making felt-containing cork granules. U. S. patent 2,858,210. Filed Aug. 19, 1955. 4 claims. Assigned to Brown Co. [Cl. 92-3.] The cork is deaerated before being added to the papermaking fibers in the beater.

Ardell, Edgar, and Wozniak, Mitchell S. Packing machines for cans or the like. U. S. patent 2,857,721. Filed Feb. 4, 1955. 21 claims. Assigned to Emhart Mfg. Co. [Cl. 53-26.] The cans are packed into paperboard shipping cases.

Asselin, John D., and Henrickson, Russell M. Method of coating fibrous hardboard panels and resultant article. U. S. patent 2,858,236. Filed Aug. 31, 1954. 5 claims. Assigned to Whirlpool Corp. [Cl. 117-68.] A temperature-and moisture-resistant coating is applied to hardboard refrigerator panels.

Beebe, Henry C., Neff, John W., and Clymer, Wilbur L. Crayon carton and sharpener. U. S. patent 2,857,881. Filed June 17, 1957. 7 claims. Assigned to Binney & Smith Inc. [Cl. 120-1.]

Bradshaw, William H., Lynch, Addison H., and Shaw, Edward H. Alkali cellulose aging. U. S. patent 2,858,304. Filed Jan. 13, 1954. 11 claims. Assigned to Celanese Corp. of America. [Cl. 260-233.]

Brady, Charles V., and Williams, Russell J. Apparatus for and method of making bags. U. S. patent 2,857,826. Filed Dec. 8, 1954. 12 claims. Assigned to Bemis Bro. Bag Co. [Cl. 93-20.] Improvements are provided in the manufacture of flat nongusseted diamond-bottom multi-ply paper bags.

Brundell, Per G., and Johnsson, Karl E. A. Machine for removing bark from logs. U. S. patent 2,857,945. Filed March 22, 1956. 17 claims. Assigned to Soderhamns Verkstader A. B. [Cl. 144-208.]

Byrd, Gerald J. Well drilling fluids and method of making the same. U. S. patent 2,858,271. Filed Sept. 7, 1956. 5 claims. Assigned to Lignosol Chemicals Ltd. [Cl. 252-8.5.] Spent sulphite liquor solids are used.

Duncan, James K., Doerner, Ernest H., and Dreyer, William H. Method of and apparatus for conditioning business machine cards and the like. U. S. patent 2,857,825. Filed Jan. 25, 1955. 18 claims. Assigned to Cummins-Chicago Corp. [Cl. 92-68.] The apparatus mechanically reconditions cards which have been torn, worn, or the like.

Durant, Leonard G., Irvine, James E., Pennington, Rohe V., and Surino, Alphonse. Apparatus for wood chip digestion. U. S. patent 2,858,211. Filed Feb. 13, 1956. 4 claims. Assigned to Condi Engineering Corp. [Cl. 92-7.] Discharge means are provided for a vertical continuous digester or chip-presteaming tank.

Durant, Leonard G., Irvine, James E., Pennington, Rohe V., and Surino, Alphonse. Wood chip digestion. U. S. patent 2,858,213. Filed April 20, 1956. 11 claims. Assigned to Condi Engineering Corp. [Cl. 92-7.] A method and apparatus for the continuous digestion of wood chips is provided.

Durant, Leonard, G., Irvine, James E., Pennington, Rohe V., and Surino, Alphonse. Wood chip feeders. U. S. patent 2,858,212. Filed Feb. 13, 1956. 10 claims. Assigned to Condi Engineering Corp. [Cl. 92-7.] Means are provided to feed the wood chips into a pressurized steam pretreatment zone.

Fair, Albert E. H. Apparatus for dewatering fibrous tubing. U. S. patent 2,857,824. Filed Dec. 12, 1955. 3 claims. Assigned to Brown Co. [Cl. 92-59.] Three cooperating segments are closed about the tube formed on the winding mandrel.

Fromm, Fred, and Watson, Charles S. Bank by mail envelope. U. S. patent 2,858,061. Filed Oct. 10, 1955. 1 claim. Assigned to Berlin & Jones Co., Inc. [Cl. 229-70.]

Geary, Robert J. Pesticidal composition containing a water dispersible lignin sulfonic acid. U. S. patent 2,858,250. Filed June 13, 1955. 7 claims. [Cl. 167-42.] The composition also may contain tall oil esters.

Gonser, Milo F. Method of making panels. U. S. patent 2,857,632. Filed March 12, 1954. 1 claim. Assigned to Semico Inc. [Cl. 20-15.] A constructional panel comprises three wooden boards nailed together in stepped fashion with building paper between the layers.

Gooding, Chester M., Melnick, Daniel, and Yahlteich, Hans W. Novel and improved packaging process. U. S. patent 2,858,225. Filed June 16, 1954. 16 claims. Assigned to Best Foods, Inc. [Cl. 99-171.] Glassine paper is treated to minimize mold formation in foods wrapped therein.

Haglund, Gustaf. Method of producing sulphite acid. U. S. patent 2,858,192. Filed April 1, 1953. 3 claims. [Cl. 23-178.]

Heys, Ralph C. Synchronized tail cutter and suction roll traveling sealing strip. U. S. patent 2,857,822. Filed Jan. 12, 1953. 11 claims. Assigned to Beloit Iron Works. [Cl. 92-38.]

Hughes, Harold K. Preparation of spinning solutions. U. S. patent 2,858,228. Filed Sept. 4, 1956. 9 claims. Assigned to Celanese Corp. of America. [Cl. 106-190.] Heat-treating a cellulose acetate spinning solution improves its viscosity, filterability, and spinning stability characteristics.

Hughes, Harold K. Preparation of spinning solutions. U. S. patent 2,858,229. Filed Oct. 6, 1954. 12 claims. Assigned to Celanese Corp. of America. [Cl. 106-198.] An improved spinning solution of cellulose acetate is provided.

Ishler, William E., and Cressman, George W. Method of coating lamps. U. S. patent 2,858,234. Filed Oct. 24, 1955. 5 claims. Assigned to General Electric Co. [Cl. 117-33.5.] Cellulose nitrate is employed in a binder in a coating composition for fluorescent lamps.

Johnson, William L. Apparatus for preparing abrasive articles. U. S. patent 2,857,879. Filed Sept. 1, 1955. 5 claims. Assigned to Abrasive Co. of America. [Cl. 118-623.] The apparatus coats an adhesively surfaced backing material with abrasive particles by an electrostatic deposition process.

Kerr, Ralph W. Process for the preparation of alkyl ethers of starch in unswollen granule form. U. S. patent 2,858,305. Filed Jan. 26, 1956. 8 claims. Assigned to Corn Products Refining Co. [Cl. 260-233.3.]

Kircher, John G. Stamp pad. U. S. patent 2,857,877. Filed Nov. 13, 1956. 3 claims. [Cl. 118-264.] An inking pad for use with a rubber stamp comprises two left pads adhered to a backing sheet of corrugated board.

Kitchell, Thorne C. Produce box. U. S. patent 2,858,058. Filed Dec. 10, 1954. Issued Oct. 28, 1958. 5 claims. Assigned to Union Bag-Camp Paper Corp. [Cl. 229-33.]

Kitchell, Thorne C. Produce container. U. S. patent 2,858,059. Filed Nov. 12, 1957. Issued Oct. 28, 1958. 4 claims. Assigned to Union Bag-Camp Paper Corp. [Cl. 229-45.] A produce shipper can be stacked without cutting off air circulation, permits bulge packing, and has improved cover-locking means.

Koziol, Bernard J. Packaging means. U. S. patent 2,858,014. Filed July 5, 1956. 1 claim. Assigned to Arvey Corp. [Cl. 206-47.] A paperboard carton for packaging an irregularly shaped article is provided with an interior packing element formed of molded pulp.

Küchler, Karl. Ripping or tear-off closure for containers of paper, cardboard or the like material and method of producing the same. U. S. patent 2,858,060. Filed Oct. 24, 1955. 4 claims. Assigned to Jagenberg-Werke Akt.-Ges. [Cl. 229-51.]

Labombarde, Raymond A. Apparatus for folding leading flaps. U. S. patent 2,857,827. Filed Aug. 9, 1954. 11 claims. [Cl. 93-49.]

McCain, William W., and Hillman, Chester E. Machine for gluing book backs. U. S. patent 2,858,007. Filed June 1, 1954 8 claims. Hillman's interest assigned to McCain. [Cl. 198-29.]

Mendelsohn, Meyer. Separator for alkaline batteries. U. S. patent 2,858,353. Filed July 6, 1954. 13 claims. Assigned to Ions Exchange & Chemical Corp. [Cl. 136-146.] Methylcellulose and alkali alginates are employed.

Mullinix, Charles D. Packages. U. S. patent 2,858,057. Filed April 19, 1954. Issued Oct. 28, 1958. 2 claims. [Cl. 229-4.5.] A metal-end paper can is designed to resist internal pressures.

Saphier, Michael C. Dispenser and shelf. U. S. patent 2,858,086. Filed Jan. 12, 1955. 3 claims. Assigned to Lincoln Metal Products Corp. [Cl. 242-55.4.] A wall-mounted dispenser holds three rolls of household utility materials such as waxed paper.

Schappel, Joseph W. Viscose spinning process. U. S. patent 2,858,185. Filed Jan. 12, 1952. 7 claims. Assigned to American Viscose Corp. [Cl. 18-54.] A reaction product of formaldehyde and polyacrylamide is deposited in the regenerated cellulose article to decrease the water-sensitivity thereof.

Solomon, Frank. Separators for electric batteries. U. S. patent 2,858,352. Filed March 8, 1955. 5 claims. Assigned to Yardney International Corp. [Cl. 136-145.] The projecting edges of the cellophane or paper separators are treated with polyvinyl acetate.

Tamarin, Bernard J., and Meletti, Adolph. Art of packaging. U. S. patent 2,857,720. Filed Jan. 19, 1953. 9 claims. Assigned to Pull-Packaging, Inc. [Cl. 53-14.] A pull-tab is incorporated in an otherwise conventional cigarette package so that

pulling on the tab opens the pack and partially draws out one of the cigarettes.

Thiessen, George J. Suction roll silencer. U. S. patent 2,857,823. Filed May 9, 1955. 7 claims. Assigned to National Research Council. [Cl. 92-53.]

Thomsen, Alfred M. Method of making titanium dioxide. U. S. patent 2,858,193. Filed Dec. 21, 1953. 3 claims. Assigned to Champion Paper and Fibre Co. [Cl. 23-202.] Spent sulphite liquor is used.

Vines, Oscar L., and Hackenberg, Robert A. Carton. U. S. patent 2,858,013. Filed Dec. 4, 1956. 9 claims. Assigned to Continental Paper Co. [Cl. 206-45.31.] Several modifications of a transparent-top display box are described.

Watson, William B. Sound-deadening composition of matter. U. S. patent 2,858,231. Filed Jan. 14, 1954. 4 claims. Assigned to Sinclair Refining Co. [Cl. 106-285.] Roofing felts, asbestos fibers, or the like are saturated with an aromatic petroleum resin fraction of specified characteristics to provide a sound-deadening composition.

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Carter, Melvin A. Illuminating display device for photographic transparencies. U. S. patent 2,858,629. Filed Jan. 5, 1956. 12 claims. [Cl. 40-106.1.] Paperboard is employed in forming an enclosed windowed illuminated easel-supported display device for photo transparencies.

Clark, Bryce L., and Miller, Carl S. Method of making permanent fascimile copies. U. S. patent 2,859,351. Filed Oct. 25, 1954. 4 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl. 250-65.] A thermographic duplicating system and types of thermosensitive papers therefore are described.

Cotton, William J. Article of manufacture for planting in pulp containers. U. S. patent 2,858,647. Filed Oct. 14, 1954. 1 claim. Assigned to Keiding Paper Products Co. [Cl. 47-37.] This is a rot-resistant molded pulp flower pot.

Cubberley, Richard H., and Dell, M. B. Wax-resin emulsion for water vaporproofing paper and method of producing same. U. S. patent 2,859,190. Filed Aug. 26, 1953. 3 claims. Assigned to Patent and Licensing Corp. [Cl. 260-28.5.]

Curry, Malcolm. Spool boxing machines. U. S. patent 2,858,656. Filed Oct. 5, 1956. 6 claims. Assigned to American Thread Co. [Cl. 53-166.] The machine provided packs a dozen spools of sewing thread into an open-topped paperboard box.

Franzmann, William H. Machine for making manifold forms. U. S. patent 2,859,035. Filed Oct. 1, 1954. 4 claims. Assigned to Hamilton Tool Co. [Cl. 271-2.1.]

Goodwillie, John E. Suction forming paper machine. U. S. patent 2,858,746. Filed Feb. 1, 1955. 11 claims. Assigned to Beloit Iron Works. [Cl. 92-44.]

Gorman, John E. Cake dummy and blank therefor. U. S. patent 2,858,630. Filed Aug. 27, 1954. 5 claims. [Cl. 40-126.]

Guthrie, John. Wrapper applicating apparatus. U. S. patent 2,858,657. Filed Oct. 6, 1954. 24 claims. Assigned to Alaska Pine & Cellulose Ltd. [Cl. 53-218.] The apparatus applies a paper wrapping to a pulp bale.

Hawkinson, Alfred T., Hull, Hugh G., and Young, James H. Process for bleaching webs of fibrous cellulose material with hydrogen peroxide vapor containing water vapor. U. S. patent 2,859,087. Filed March 28, 1955. 13 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 8-104.] Paper is bleached on the paper machine.

Hawley, Don M., and Williams, John C. Felted products containing glass filaments. U. S. patent 2,859,109. Filed Dec. 31, 1954. 9 claims. Assigned to Hawley Products Co. [Cl. 92-3.] Felted articles are formed by standard papermaking techniques from a furnish including bundles of resin-coated glass filaments without disintegrating the bundles.

Honeyman, Robert B. Rotor with spaced large shredding blades cooperating with toothed stator. U. S. patent 2,858,990. Filed July 29, 1957. 4 claims. Assigned to Morden Machines Co. [Cl.241-260.] This is an improvement on the Morden apparatus for shredding and slushing waste paper and dried pulp sheets.

Johnson, Thomas H. Opening and closure device. U. S. patent 2,858,961. Filed July 18, 1956. 4 claims. [Cl. 222-81.] A paperboard cereal carton is provided with a metal device which may be used as a knife to open the carton or as an attachable pouring spout.

Mahaffy, Reid A., Young, William E., and Di Monico, George S. Machine and process for evacuating, gassing, and sealing flexible containers. U. S. patent 2,858,655. Filed Feb. 18, 1955. 19 claims. Assigned to Standard Packaging Corp. [Cl. 53-86.]

Messing, Hjalmar S. Steam nozzle for pulp producing apparatus. U. S. patent 2,858,973. Filed July 16, 1954. 3 claims. Assigned to American Defibrator, Inc. [Cl. 230-92.] A steam-discharge and condensing nozzle is provided for pulp defibrators and the like.

Pellaton, Ernest C. Carton construction. U. S. patent 2,858,968. Filed April 26, 1954. 3 claims. Assigned to Fibreboard Paper Products Corp. [Cl. 229-37.] Improved construction is provided in a carton having a hexagonal body and a separate flanged hexagonal cover element.

Petrea, James C., and Howe, James W., Jr. Bag applying and filling machine. U. S. patent 2,859,036. Filed March 10, 1955. 13 claims. Assigned to Sperry Rand Corp. [Cl. 271-26.]

Reeves, Wilson A., Chance, Leon H., and Drake, George L., Jr. Flame resistant organic textiles and method of production. U. S. patent 2,859,134. Filed April 24, 1957. 6 claims. Assigned to U. S. Secretary of Agriculture. [Cl. 117-136.] The flameproofing method described is applicable to paper and board.

Reno, Roy E. Composition and method for preventing putty stains. U. S. patent 2,859,126. Filed Aug. 6, 1957. 6 claims. [Cl. 117-6.] Methylcellulose is used.

Richards, John C. Process for the manufacture of a synthetic leather. U. S. patent 2,858,570. Filed Jan. 20, 1956. 1 claim. Assigned to E. I. du Pont de Nemours and Co. [Cl. 18-47.5.]

Ropella, Leonard A. Fireproof door core of phenol formaldehyde, wood chips, and diammonium phosphate. U. S. patent 2,859,187. Filed July 6, 1954. 3 claims. Assigned to Roddis Plywood Corp. [Cl. 260-17.2.]

Rosenblad, Curt F. Method for preparing digestion acid for digestion of sulphite. U. S. patent 2,859,108. Filed May 25, 1954. 5 claims. Assigned to Aktiebolaget Rosenblads Patenter. [Cl. 92-2.]

Sandstrom, Stephen C. Envelope opening means. U. S. patent 2,858,971. Filed June 1, 1956. 1 claim. [Cl. 229-86.] A tear strip opener is provided in a paper envelope.

Sanford, Marcus E. Method and apparatus for treatment of waste paper stock. U. S. patent 2,859,110. Filed March 26, 1956. 11 claims. Assigned to Fibreboard Paper Products Corp. [Cl. 92-20.] Foreign particles are removed and the wax content is dispersed.

Seaman, Stewart E., and Seaman, Stewart L. Method of producing alkali cellulose. U. S. patent 2,859,210. Filed Dec. 10, 1956. 4 claims. [Cl. 260-233.]

Seyforth, Rome C. Hardware display card with self-locking fastener. U. S. patent 2,858,938. Filed May 23, 1957. 2 claims. Assigned to Shelby Metal Products Co. [Cl. 206-80.]

Uhrmacher, Ralph R. Asphalt roofing composition. U. S. patent 2,859,125. Filed May 27, 1957. 3 claims. Assigned to Panther Oil & Grease Mfg. Co. [Cl. 106-278.] Asphalt for coating or laminating is blown in the presence of phosphorus pentoxide and a xylene-petroleum naphtha solvent.

Wagner, Rudolf E. Rotary presses and the like. U. S. patent 2,858,747. Filed Feb. 7, 1956. 4 claims [Cl. 92-49.] Improved suction means are provided to remove water from the nip of press rolls.

Williams, Benjamin M. Multi-trip shipping container. U. S. patent 2,858,969. Filed March 23, 1956. 1 claim. Assigned to Crown Zellerbach Corp. [Cl. 229-44.] This is a bottle case of improved design.

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Altenbern, Gustav, A., and Bruce, Jay C. Package construction. U. S. patent 2,859,866. Filed March 9, 1956. 1 claim. Assigned to Gem, Inc. [Cl. 206-45. 31.] This is a display carton for packaging a dust mop.

Aronson, Theodore F., and Lyon, Floyd A. Sheet feeding mechanism. U. S. patent 2,859,964. Filed Feb. 19, 1957. 11 claims. [Cl. 271-29.]

Benedict, Stephen W., Kelly, Thomas M. and Jacox, Paul B. Hydraulic cement additives and cement compositions containing same. U. S. patent 2,860,060. Filed March 6, 1956. 16 claims. Assigned to American-Marietta Co. [Cl. 106-90.] Spent sulphite liquor is used.

Berlyn, Martin J. Method and apparatus for forming pulp stock into a sheet. U. S. patent 2,859,668. Filed July 2, 1956. 20 claims. Assigned to Dominion Engineering Works Ltd. [Cl. 92-44.] A headbox is provided for a radically modified fourdrinier section.

Burnett, Alexander H. Cartoning machine. U. S. patent 2,859,570. Filed Aug. 22, 1955. 14 claims. Assigned to Swift & Co. [Cl. 53-3.] The machine forms a unitized merchandising pack by forming a paperboard cartonlike wrapper about three cans of household cleanser.

Choate, James R. Combination paperboard berry box and snap lid therefor. U. S. patent 2,859,905. Filed Aug. 26, 1957. 5 claims. Assigned to Riverside Mfg. Co., Inc. [Cl. 229-16.]

Cohen, Samuel A., and Mower, Ernest R. Felt base floor covering and method of making the same. U. S. patent 2,860,071. Filed Oct. 21, 1953. 11 claims. Assigned to Bonafide Mills, Inc. [Cl. 117-72.]

De Villers, Edmund J. Adjustable, disposable-type cap construction. U. S. patent 2,859,447. Filed April 20, 1955. 3 claims. Assigned to Paperlynen Co. [Cl. 2-197.] This is a paper cap of the type worn by lunch counter attendants and the like.

Duchacek, Charles F. Stablized hydrocarbon waxes. U. S.

patent 2,860,064. Filed Jan. 26, 1955. 4 claims. Assigned to Socony Mobil Oil Co., Inc. [Cl. 106-268.] This is similar to U. S. patent 2,860,065 (Nov. 11, 1958).

Duchacek, Charles F. Stabilized petroleum wax. U. S. patent 2,860,065. Filed Jan. 26, 1955. 4 claims. Assigned to Socony Mobil Oil Co., Inc. [Cl. 106-270.] Additives to paper-coating waxes render them resistant to temperature, light, and oxidation.

Dunn, James F. Method of making disposable tooth brushes. U. S. patent 2,860,011. Filed March 25, 1953. 3 claims. [Cl. 300-21.] Paperboard impregnated with dentifrice is employed.

Eiken, Bert M. Trouser cuff tack. U. S. patent 2,860,081. Filed Nov. 22, 1954. 6 claims. [Cl. 154-53.5.] Pressure-sensitive paper-base adhesive tape is used.

French, Clayton V., and Ihne, Elmer R. Method of manufacturing fiber-cement sheets. U. S. patent 2,859,484. Filed May 25, 1954. 15 claims. Assigned to Johns-Manville Corp. [Cl. 18-60.]

Godshalk, Henry W. Coating composition comprising a methyl methacrylate polymer and a cellulose ester and process for preparing same. U. S. patent 2,860,110. Filed June 4, 1954. 15 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-17.]

Gräfingholt, Alfred. Feeding arrangement for feeding mass produced articles to single conveying rows. U. S. patent 2,859,855. Filed Jan. 18, 1956. 7 claims. Assigned to Hansella-Werke Albert Hankel A. G. [Cl. 198-32.] This is a feeder for a candy wrapping machine.

Greig, James W. Laminated trim sheet and method of making same. U. S. patent 2,859,795. Filed Dec. 27, 1955. 5 claims. Assigned to Woodall Industries, Inc. [Cl. 154-110.] The auto panel trim sheet includes paper mats laminated to a paper or board backing.

Griffith, George L., Jr., and Samuel, David G., Jr. Blasting explosives. U. S. patent 2,860,041. Filed Nov. 17, 1955. 6 claims. Assigned to Trojan Powder Co. [Cl. 52-11.] Sodium carboxymethylcellulose is used.

Guyer, Reynolds. Telescoping carton. U. S. patent 2,859,906. Filed March 7, 1955. 4 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-31.]

Hartman, Harold E. Combination packing, shipping and dispensing carton. U. S. patent 2,859,897. Filed Jan. 3, 1956. 5 claims. [Cl. 221-305.] The carton is for a stack of nested paper cups.

Hitchcock, Reuben, Jr., Cardon, Samuel Z., and Alvord, Earl T. Cigarette wrapper material and method for producing same. U. S. patent 2,859,753. Filed March 23, 1956. 13 claims. Assigned to Rand Development Corp. [Cl. 131-15.] Cigarette paper is impregnated with an ammonia-releasing material.

Hoel, Leroy W., and Wolfe, Dexter, L. Method of coating paper. U. S. patent 2,860,073. Filed Aug. 8, 1956. 10 claims. Assigned to Kimberly-Clark Corp. [Cl. 117-76.] A method of insolubilizing proteinaceous coating binder is provided.

Jauquet, Jean. Pocket speaking devices. U. S. patent 2,859,974. Filed Aug. 18, 1953. 4 claims. [Cl. 274-16.] This is a paperboard phonograph designed for advertising usage.

Lehmann, Harry. Apparatus for closing and sealing containers. U. S. patent 2,859,575. Filed May 22, 1953. 5 claims. [Cl. 53-341.] The machine clinches a cover to the flanged beaded mouth of a cuplike paper container.

Leitzel, Ammon M. Pulp molding apparatus. U. S. patent 2,859,669. Filed Nov. 18, 1955. 5 claims. Assigned to Pacific Pulp Molding Co. [Cl. 92-56.] A flexible diaphragm is used to smooth the outer surface of articles formed on suction dies.

McFarland, Gerald B. Envelope construction. U. S. patent 2,859,907. Filed April 19, 1956. 4 claims. Assigned to M. B. McFarland & Sons. [Cl. 229-85.] This is a self-sealing envelope with tear-strip opener.

Marcheski, Ruth E. Carton lifter. U. S. patent 2,860,000. Filed April 8, 1955. 5 claims. [Cl. 294-28.] A device is provided for use as a handle in holding and lifting a number of gable-top milk cartons.

Mestre, Luis. Sheet delivery means for rotary offset printing presses. U. S. patent 2,859,692. Filed Aug. 18, 1954. 11 claims. Assigned to Lewfor Development Corp. [Cl. 101-217.]

Moncrieff, Leslie J. Packaging. U. S. patent 2,859,572. Filed July 5, 1956. 7 claims. Assigned to British Celanese Ltd. [Cl. 53-32.] The machine wraps an open-top paperboard box filled with produce in an outer covering of cellophane.

Moulden, Oscar O. Wire package. U. S. reissue patent 24,560. Filed May 22, 1958. 5 claims. [Cl. 242-137.1.] The dispensing carton contains a freely rotating spool about which the wire is wound.

Older, Lincoln G. Bib. U. S. patent 2,859,446. Filed June 14, 1956. 1 claim. Assigned to Paterson Pacific Parchment Co. [Cl. 2-52.] The bib is formed from a paper blank, the construction including integral tying members.

Olivette, Ralph K. Bag filling machine. U. S. patent 2,859,574. Filed Oct. 12, 1954. 2 claims. Assigned to Ames Harris Neville Co. [Cl. 53-261.]

Olsson, Ingemar. Method for the manufacture of a cigarette package envelope and package envelope produced according to this method. U. S. patent 2,859,671. Filed April 8, 1955. 1 claim. Assigned to Research Aktiebolag. [Cl. 93-36.]

Paige, Richard E. Sound emitting instrument. U. S. patent 2,859,555. Filed July 8, 1955. 1 claim. [Cl. 46-179.] A paperboard blank sets up to form a toy whistle.

Phin, Sidney R., and Kempler, Fred. Gluing device for box forming machines. U. S. patent 2,859,727. Filed July 31, 1953. 2 claims. [Cl. 118-3.]

Polizzi, Anthony C. Coffee filtering retainers. U. S. patent 2,859,684. Filed Feb. 19, 1951. 1 claim. [Cl. 99-310.] A filter paper device for use in the perforated cup of a coffee percolator is described.

Provine, Robert W., Mehlhorn, Lawrence T., Thompson, Warren L. and Lawson, John V. Stabilized paraffin wax resistant to discoloration by light. U. S. patent 2,860,066. Filed June 6, 1955. 10 claims. Assigned to D-X Sunray Oil Co. [Cl. 106-270.] The wax is for use in food packaging applications.

Pruner, Ronald L. Viewer. U. S. patent 2,859,548. Filed March 12, 1957. 2 claims. [Cl. 40-63.] A paperboard blank is set up to form a device of use in viewing a photo film strip.

Rawe, Martin. Securing device for valve-bags in valve-bag manufacturing machines. U. S. patent 2,859,670. Filed Oct. 1, 1954. 8 claims. [Cl. 93-8.]

Reinartz, Robert, and Rupp, Fritz. Intermediate stacking device for sheets delivered by a printing machine. U. S. patent 2,859,966. Filed Oct. 26, 1955. 6 claims. Assigned to Maschinenfabrik Augsburg-Nürnberg A. G. [Cl. 271-86.]

Sockey, Cecil M. Suction cleaner for doctor blades for drying rollers. U. S. patent 2,859,537. Filed May 24, 1954. 6 claims. [Cl. 34-85.]

Triolo, Louis. Envelope making machine. U. S. patent 2,859,672. Filed May 10, 1956. 4 claims. [Cl. 93-61.] The machine makes a phonograph record jacket.

White, Blanche B., and Smart, Charles L. Production of organic esters of cellulose by heterogeneous esterification. U. S. patent 2,860,132. Filed Nov., 1, 1955. 6 claims. Assigned to Celanese Corp. of America. [Cl. 260-227.]

Williams, Barney B. Cigarette retaining means. U. S. patent 2,859,865. Filed July 5, 1957. 7 claims. [Cl. 206-41.] A cigarette package is provided with a protective strip which overlies the ends of the cigarettes after the pack is opened, but which is easily lifted to expose the cigarettes.

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Allen, Robert K. Apparatus for burning residual liquor. U. S. patent 2,860,611. Filed Jan. 27, 1955. 2 claims. Assigned to The Babcock & Wilcox Co. [Cl. 122-240.] A furnace for spent sulphite liquor is described.

Arneson, Lawrence E. Can packaging apparatus. U. S. patent 2,860,461. Filed Jan. 21, 1955. 27 claims. Assigned to Federal Paper Board Co., Inc. [Cl. 53-56.] An open-end six-pack can package is formed.

Bain, Lewis A. Jr., and Geshner, Robert A. Methods of making printed wiring circuits. U. S. patent 2,861,029. Filed Dec. 14, 1955. 1 claim. Assigned to Western Electric Co., Inc. [Cl. 204-15.]

Ball, Cecil G. Coin holder folder. U. S. patent 2,860,774. Filed June 13, 1956. 1 claim. [Cl. 206-84.] The holder comprises accordion-hinged paperboard leaves, each having coin-receiving recesses.

Bell, Leo R. Wrapper feed mechanism for wrapping machines. U. S. patent 2,860,469. Filed Feb. 25, 1954. 8 claims. Assigned to American Machine & Foundry Co. [Cl. 53-389.] Improved paper web tensioning and supply means is provided in a machine for wrapping bread loaves.

Belt, Salem F. Cyanoethylation process. U. S. patent 2,860,946. Filed Aug. 15, 1955. 14 claims. Assigned to Monsanto Chemical Co. [Cl. 8-120.] A cellulose cyanoethylation process is described.

Brundell, Per G., and Jonsson, Karl E. A. Arrangements for disintegrating slivers of bark in debarking machines of the so-called hollow-head type. U. S. patent 2,860,672. Filed Nov. 13, 1956. 10 claims. Assigned to Soderhamns Verkstader AB. [Cl. 144-208.]

Clemens, Clarence M., and Jane, Clarence W. Container opening mechanism. U. S. patent 2,860,467. Filed Sept. 15, 1955. 7 claims. Assigned to Ex-Cell-O Corp. [Cl. 53-266.] The apparatus provided opens the tops of preformed gable-top milk containers prior to a filling operation.

Conover, Richard A. Paper guide for printing press. U. S. patent 2,860,876. Filed April 16, 1956. 5 claims. [Cl. 271-60.]

Cooke, John A. Service envelope. U. S. patent 2,860,826. Filed May 14, 1957. 1 claim. Assigned to Berlin & Jones Co., Inc. [Cl. 229-72.] Inserts in an envelope are held in separate compartments with indicia on each visible through separate windows in the envelope.

Corbin, Wesley S. Flow evener roll for papermaking machines.

U. S. patent 2,860,552. Filed Jan. 26, 1955. 4 claims. Assigned to Black-Clawson Co. [Cl. 92-44.]

Cox, Norman L. Regenerated cellulose structures and process for producing them. U. S. patent 2,860,480. Filed April 18, 1956. 8 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 57-140.] Thick-skin high tenacity filaments are produced.

Fielding, Francis W. Four-bottle collapsible carrier. U. S. patent 2,860,816. Filed June 20, 1955. 2 claims. Assigned to Lengsfield Brothers, Inc. [Cl. 220-113.]

Frankenstein, William P. Carton. U. S. patent 2,860,823. Filed June 5, 1952. 6 claims. [Cl. 229-31.] A collapsible relatively flat paperboard carton having side and end walls of hollow construction is designed to provide reinforcing of the two opposed end walls.

Geisinger, John R. Beverage infusion package. U. S. patent 2,860,989. Filed Feb. 12, 1957. 2 claims. [Cl. 99-77.1.] A tea bag and tag unit are held in an individual waterproof envelope which may be used as a disposal receptacle for the bag after use.

Hazeltine, James E., Jr. Method of making coated floor coverings. U. S. patent 2,861,007. Filed Jan. 18, 1954. 2 claims. Assigned to Armstrong Cork Co. [Cl. 117-15.] A method of applying a vinyl plastic surface layer to a seal-coated asphalt-saturated felt is described.

Ingram, Marvin L. Wrapping machines. U. S. patent 2,860,466. Filed May 8, 1956. 12 claims. Assigned to Bellingham Steel Products, Inc. [Cl. 53-223.] The machine wraps cartons, trays, or the like in wrapping paper severed from a supply roll.

Jacobsen, Paul W. Remote control edge alignment device. U. S. patent 2,860,841. Filed Sept. 16, 1953. 9 claims. Assigned to H. G. Weber & Co. [Cl. 242-57.1.] This is similar to U. S. patent 2,860,840 (Nov. 18, 1958).

Jacobsen, Paul W., and Weber, Herbert H. Remote control edge alignment device. U. S. patent 2,860,840. Filed Aug. 12, 1952. 3 claims. Assigned to H. G. Weber & Co. [Cl. 242-57.1.] Machines for performing a converting operation on a paper web are provided with means for controlling the web edge alignment at a point remote from the supply roll.

Johnson, Arnold E. Foldable display piece. U. S. patent 2,860,439. Filed Aug. 10, 1955. 1 claim. Assigned to Arvey Corp. [Cl. 41-11.] A paperboard blank folds into geometric shapes for use as background pieces in window or floor display.

Leroi, Ernest. Method of roasting sulphur ores in suspension. U. S. patent 2,860,964. Filed Oct. 4, 1954. 3 claims. Assigned to Societe Anonyme dite: Krebs & Cie. [Cl. 75-9.]

Macholl, James F. Electrolyte liquid for storage batteries. U. S. patent 2,861,016. Filed June 4, 1956. 1 claim. Assigned to Gould-National Batteries, Inc. [Cl. 136-154.] The life of the cellulose fiber separators is prolonged by dissolving silver sulphate in the aqueous sulphuric acid electrolyte.

Mancuso, Joseph P. Box forming machine. U. S. patent 2,860,549. Filed June 8, 1954. 10 claims. Assigned to Robert E. Bauer. [Cl. 93-51.] The machine forms and fills a flat window-top box for a pie or the like.

Mench, John W., and Fulkerson, Brazelton. Preparation of nitrogen containing cellulose derivatives. U. S. patent 2,861,068. Filed Nov. 1, 1956. 8 claims. Assigned to Eastman Kodak Co. [Cl. 260-227.]

Montgomery, James A., and Morton, Ralph D. Carton partition for artificial silk cops. U. S. patent 2,860,825. Filed Feb. 24, 1955. 1 claim. Assigned to Eastman Kodak Co. [Cl. 229-42.]

Rambold, Adolf G. F. Cartoning devices. U. S. patent 2,860,460. Filed Feb. 23, 1954. 22 claims. Assigned to Teepack Spezialmaschinen, G. m. b. H. [Cl. 53-26.] Tea bags in individual envelopes are stacked and cartoned.

Salditt, Ferdinand. Adhesive tape and method of making the same. U. S. patent 2,861,006. Filed Feb. 19, 1957. 10 claims. Assigned to The Scholl Mfg. Co., Inc. [Cl. 117-7.]

Sherrington, John E. Apparatus for feeding sheets, such as labels, from a pack to positions at which they are required. U. S. patent 2,860,804. Filed July 25, 1955. 13 claims. Assigned to Purdy Machinery Co., Ltd. [Cl. 261-54.]

Shields, Albert F. Partition assembly machine. U. S. patent 2,860,554. Filed April 16, 1953. 5 claims. Assigned to S. & S. Corrugated Paper Machinery Co., Inc. [Cl. 93-37.]

Sievers, Fred R. Paper lining apparatus for papermaking machines of the fourdrinier type. U. S. patent 2,860,551. Filed June 15, 1956. 2 claims. Assigned 50% to Herbert Malarkey. [Cl. 92-39.] A suction forming unit forms a secondary sheet of paper and applies it to a web formed on a conventional fourdrinier.

Spiegel, Edwin J., Jr., and Schoknecht, Robert J. Carrying container. U. S. patent 2,860,771. Filed Nov. 12, 1953. 5 claims. Assigned to Crown Zellerbach Corp. [Cl. 206-65.] An open-topped paperboard carrier for three bottles is described.

Stark, Donald L. Paper machinery. U. S. patent 2,860,550. Filed Sept. 28, 1956. 6 claims. Assigned to Black-Clawson Co. [Cl. 92-23.] A broke repulping apparatus is provided.

Steinmann, Henry W., and Dunay, Michael. Dewatering cellulose ester composition. U. S. patent 2,861,038. Filed March 3, 1955. 6 claims. Assigned to Celanese Corp. of America. [Cl. 210-23.]

Sykes, Thomas R. Machine for wrapping bundles or stacks of newspapers. U. S. patent 2,860,462. Filed Aug. 11, 1955. 15 claims. Assigned to The Toronto Star Ltd. [Cl. 53-66.]

Vogl, Hugh W. Automatic device for the manufacture of parcel carriers. U. S. patent 2,860,553. Filed Nov. 9, 1954. 6 claims. [Cl. 93-1.] The carrier is gummed paper tape having looped ribbon handles affixed thereto and is produced as a roll of separable carriers.

Wagner, Leo F., and Schreiber, Milton N. Storage and sales package. U. S. patent 2,860,770. Filed Nov. 15, 1956. 3 claims. Assigned to Ira J. Seigfried. [Cl. 206-46.] A laminated structure of wadding, textile, and diamond paper forms a folding storage and display envelope for precious gems.

Weaver, Paul J., and Titchenal, Oliver R. Apparatus for filling containers to a precise weight. U. S. patent 2,860,849. Filed Sept. 23, 1955. 15 claims. Assigned to St. Regis Paper Co. [Cl. 249-63.] This is similar to U. S. patent 2,860,848 (Nov. 18, 1958).

Weaver, Paul J., and Titchenal, Oliver R. Container filling apparatus. U. S. patent 2,860,848. Filed Sept. 23, 1955. 9 claims. Assigned to St. Regis Paper Co. [Cl. 249-63.] The apparatus provided fills containers (e.g., 100-lb. bags of sugar) to an accurate weight at a high rate of speed.

Wells, Roger. Pulp stock thickener. U. S. patent 2,860,973. Filed Dec. 31, 1956. 12 claims. Assigned to Diamond Gardner Corp. [Cl. 92-20.]

Willbrandt, Franklin M. Carton filling and weighing machine. U. S. patent 2,860,847. Filed Feb. 8, 1954. 3 claims. Assigned to Battle Creek Packaging Machines, Inc. [Cl. 249-59.] A machine including a balance beam weighing scale fills a carton to a predetermined weight with a granular or other flowing material and advances the full carton to make room for an empty container.

Williamson, Marshall I. Cutting and creasing dies. U. S. patent 2,860,555. Filed Dec. 27, 1955. 4 claims. [Cl. 93-58.] Cutting and creasing dies for use in producing box blanks are supported in simplified corner blocks.

Wolter, Harry A. Article counting and assembling. U. S. patent 2,860,465. Filed April 19, 1957. 13 claims. Assigned to Diamond Gardner Corp. [Cl. 53-197.] A machine for wrapping clothespins is provided with means to unitize pin groups prior to the wrapping.

Zackheim, Eli A. Multiple roll package. U. S. patent 2,860,773. Filed June 4, 1957. 13 claims. Assigned to Johnson & Johnson. [Cl. 206-65.] A paperboard carton supports a number of rolls of adhesive tape, the rolls being out of contact with the carton walls.

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Auer, Frederick G. Table or skid lowering mechanism. U. S. patent 2,861,805. Filed July 8, 1953. 8 claims. Assigned to Champlain Co., Inc. [Cl. 271-88.] Means are provided for making fine adjustments of the rate of descent of a sheet delivery table.

Baumbach, Harlan L., Enkelmann, Walter, and Wargo, Lorand. Processing machine for sensitized paper and the like. U. S. patent 2,861,508. Filed Dec. 10, 1956. 6 claims. Assigned to Unicorn Engineering Corp. [Cl. 95-94.] An improved apparatus develops the image latent in an exposed light-sensitive layer carried on a relatively wide paper web.

Bennett, Andrew E. Digester control systems. U. S. patent 2,861,884. Filed Feb. 21, 1956. 1 claim. Assigned to Worthington Corp. [Cl. 92-7.] The gas-relief valve is opened only when the temperature at the top of the digester approximates that of steam at the existing pressure.

Bergmark, John C. Tape dispenser with tape-heating means. U. S. patent 2,861,539. Filed June 24, 1957. 7 claims. Assigned to Derby Sealers, Inc. [Cl. 118-59.] The machine dispenses and remoistens gummed tape.

Faltin, William G. Bag-like receptacle. U. S. patent 2,861,735. Filed June 4, 1956. 6 claims. [Cl. 229-53.] A paper trash receptacle is described.

Fleuret, Michel A. A. Plastic material produced by the reaction of cellulose triacetate with a polyol. U. S. patent 2,861,986. Filed July 31, 1956. 6 claims. [Cl. 260-226.]

Frasch, Mary E. Artcile packaging wrapper. U. S. patent 2,861,680. Filed Oct. 13, 1955. 1 claim. [Cl. 206-56.] A paper wrapper is folded upon itself to provide article-receiving pockets for flat articles such as towels.

Garman, Edward B. Collapsible carton. U. S. patent 2,861,734. Filed Oct. 9, 1956. 2 claims. Assigned to Owens-Illinois Glass Co. [Cl. 229-41.]

Halahan, John, Aronson, Theodore F., and Lyon, Floyd A. Sheet feeding means. U. S. patent 2,861,803. Filed June 16, 1955. 11 claims. [Cl. 271-29.] A suction feeder includes means

to slow the sheet at a point in its travel to permit optical scanning thereof.

Hanford, Victor R. Sealed package and method of making the same. U. S. patent 2,861,405. Filed Dec. 6, 1956. 2 claims. Assigned to National Tool Co. [Cl. 53-22.] A method of making a blister pack is described.

Holmgren, Ephraim T. Loose leaf binder. U. S. patent 2,861,576. Filed Dec. 14, 1953. 7 claims. [Cl. 129-23.]

Hornbostel, Lloyd. Device for coating a traveling sheet. U. S. patent 2,861,541. Filed Aug. 16, 1955. 6 claims. Assigned to Beloit Iron Works. [Cl. 118-119.] Improved doctoring means in a paper coater provide a smooth uniform coating despite variations in the paper thickness or in the amount of coating initially applied.

Kane, Thomas E. Pressure regulated calender to insure equal nip pressure at all points. U. S. patent 2,861,504. Filed Oct. 26, 1956. 3 claims. [Cl. 92-75.]

Lane, Dan R. Adjustable packing container for frangible plates. U. S. patent 2,861,681. Filed March 2, 1955. 4 claims. [Cl. 206-62.] A paperboard shipping container adjusts to fit various sizes of flat glass sheets.

Metzger, Henry L. Collapsible dispensing container and blank for making same. U. S. patent 2,861,733. Filed Oct. 25, 1956. 3 claims. Assigned to Fort Orange Paper Co. [Cl. 229-17.] A hinged-top cigarette package is described.

Nadel, Manuel R. Display devices. U. S. reissue patent 24,571. Filed Dec. 17, 1957. 9 claims. Assigned to Compton Co., Ltd. [Cl. 211-13.] A paperboard-backed eyeglass display panel is provided.

Parker, Edwin F. Dispensing carton with pouring spout. U. S. patent 2,861,732. Filed Nov. 3, 1954. 3 claims. (Cl. 229-17.] A carton for pourable materials is provided with an integral pouring spout construction.

Pedrick, John L., and Dawson, Charles W. Pulp meter. U. S. patent 2,861,722. Filed Dec. 7, 1954. 8 claims. Assigned to Scott Paper Co. [Cl. 222-283.] A paper-stock metering device of the trap-chamber type is designed to permit control of both volume and rate of flow over a wide range of stock quantities.

Rosenberg, Arthur J. Film mount. U. S. patent 2,861,368. Filed Jan. 4, 1956. 6 claims. [Cl. 40-158.] A three-ply paperboard mounting device is provided for a strip of photographic film.

Schneider, Robert P. Automatic tape dispenser. U. S. patent 2,861,633. Filed Sept. 26, 1956. 9 claims. Assigned to Western Electric Co., Inc. [Cl. 164-42]. Measured lengths of pressure-sensitive tape are dispensed.

Seanor, Rex C. Floating gear assembly for calender rolls. U. S. patent 2,861,435. Filed Oct. 4, 1956. 2 claims. Assigned to Adamson-United Co. [Cl. 64-9.]

Sipior, Joseph F. Paper dispensers. U. S. patent 2,861,753. Filed June 20, 1955. 6 claims. [Cl. 242-55.51.] An improved metal case is provided for dispensing paper supplied in roll form.

Skogh, Carl G. C., and Sävö, Göte E. Method for continuous production of furfural from suitable raw material. U. S. patent 2,862,008. Filed Oct. 5, 1953. 1 claim. [Cl. 260-347.9.] The raw material is wood chips or other pentosan-containing material.

Stratton, Edward B., Jr. Package for crushable articles and a method and apparatus for producing the same. U. S. patent 2,861,404. Filed Oct. 5, 1955. 5 claims. Assigned to National Tool Co. [Cl. 53-22.] A blister pack for a paint brush prevents crushing the brush bristles.

Sylvester, Edwin E., and Peck, Sumner H. Pressure-sensitive adhesive compositions for tape and methods for dispensing same. U. S. patent 2,861,899. Filed Aug. 15, 1956. 6 claims. Assigned to B. B. Chemical Co. [Cl. 117-103.]

Vines, Oscar L. Dispensing carton for paper cups. U. S. patent 2,861,717. Filed June 18, 1956. 10 claims. Assigned to Continental Paper Co. [Cl. 221-63.]

Weisman, Maurice. Infusion package with tab and method and apparatus for manufacture thereof. U. S. patent 2,861,403. Filed Feb. 27, 1956. 6 claims. [Cl. 53-14.]

Whitmire, Emmett S. Bag filling spout. U. S. patent 2,861,-604. Filed May 22, 1956. 4 claims. Assigned to Volunteer Portland Cement Co. [Cl. 141-285.] A spout for filling a valve bag is designed to partially exhaust the air from within the bag.

Winzen, Otto C. Dispensing container. U. S. patent 2,816,718. Filed April 6, 1956. 12 claims. Assigned to Winzen Research, Inc. [Cl. 222-107.] A polyethylene bag and discharge hose contained in a paperboard carton form a dispensing container for milk.

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Banks, Sydney E. Labeling machines. U. S. patent 2,862,-638. Filed Sept. 14, 1955. 12 claims. Assigned to Morgan Fairest Ltd. [Cl. 216-54.] The machine feeds, gums, and applies bottle labels.

Barrentine, Eugene M., Hodgins, Theodore S., and Shelton, Frederic J. Adhesive composition comprising phenol aldehyde resin and hydroxyalkylcellulose and method of preparing same. U. S. patent 2,862,897. Filed Sept. 16, 1954. 11 claims. Assigned to Reichhold Chemicals, Inc. [Cl. 260-14.) The plywood adhesive also includes ground fir bark or the like.

Battista, Orlando A., and Whytlaw, Graeme G. Shrinkable wrappers for annular thread packages. U. S. patent 2,862,615. Filed April 28, 1954. 16 claims. Assigned to American Viscose Corp. [Cl. 206-64.] A tissue paper carrying deposits of regenerated cellulose is used as a rayon filament wrapper.

Battista, Orlando A., and Whytlaw, Graeme G. Wrapper for wound filamentary packages. U. S. patent 2,862,614. Filed April 28, 1954. 16 claims. Assigned to American Viscose Corp. [Cl. 206-64.] Tissue paper carrying spaced deposits of regenerated cellulose or cellulose ether is used as a wrapper for a rayon cake.

Bergstein, Frank D. Self-forming pouring spout for containers. U. S. patent 2,862,649. Filed Feb. 21, 1957. 12 claims. Assigned to Bergstein Packaging Trust. [Cl. 222-531.]

Birdseye, Clarence. Semichemical pulping process. U. S. patent 2,862,813. Filed Dec. 23, 1952. 5 claims. Assigned to Process Evaluation and Development Corp. [Cl. 92-6.] A continuous process involving alternate shredding and cooking stages is described.

Birdseye, Clarence. Utilization of pith in the manufacture of pulp. U. S. patent 2,862,814. Filed March 9, 1955. 13 claims. Assigned to Process Evaluation and Development Corp. [Cl. 92-6.] A method of pulping and utilizing bagasse pith in bagasse pulp is described.

Blackford, Benjamin B., and Gross, William J. Method of making plastic strip adhesive bandages. U. S. patent 2,862,846. Filed Nov. 23, 1953. 15 claims. Assigned to Johnson & Johnson. [Cl. 154-118.] Various coated papers are used in the manufacture of a band-aid type bandage.

Boyer, Robert Q. Process for production and separation of sodium sulphide and sodium carbonate from spent liquors. U. S. patent 2,862,887. Filed Oct. 3, 1955. 8 claims. Assigned to Western Precipitation Corp. [Cl. 252-183.]

Brown, Howard G. C-ring strip package. U. S. patent 2,862,612. Filed Jan. 29, 1957. 1 claim. Assigned to Novelty Tool Co., Inc. [Cl. 206-56.] A paperboard carton supports strips of staples so that they may be moved easily from the carton to the guideway of a tool using them.

Clark, James d'A., and Lambert, Robert D. Apparatus and method for separating pressed board from caul plates. U. S. patent 2,862,291. Filed Oct. 30, 1953. 5 claims. Assigned to Changewood Corp. [Cl. 29-239.]

Dalrymple, Philip W., and Hunsaker, James P. Paper lift. U. S. patent 2,862,689. Filed Nov. 3, 1955. 4 claims. Assigned to Southworth Machine Co. [Cl. 254-8.]

Davey, John R. Sheet-moving apparatus. U. S. patent 2,862,445. Filed Sept. 8, 1954. 3 claims. Assigned to Armstrong Cork Co. [Cl. 101-407.] An improved pin band apparatus is provided for moving sheet material such as floor and wall coverings through a printing or other machine.

Dede, Joseph B., and Watson, Donald A. Laminate adhesive comprising a protein and a quadricomponent interpolymer and process for preparing same. U. S. patent 2,862,896. Filed July 17, 1956. 8 claims. Assigned to Monsanto Chemicals Co. [Cl. 260-8.] The adhesive may be used in laminating paper, hardboard, etc.

Faeber, Harry W. Threading mechanism. U. S. patent 2,862,705. Filed Aug. 13, 1956. 8 claims. Assigned to Time Inc. [Cl. 271-2.1.] The mechanism threads a web of paper or the like through a paper machine, printing machine, or the like.

Guabertm, Rene J. Apparatus for handling sheet material articles. U. S. patent 2,862,426. Filed Aug. 13, 1953. 5 claims. Assigned to Food Machinery and Chemical Corp. [Cl. 93-93.] The apparatus counts and stacks the output of machines forming paper bags, envelopes, and the like.

Gomberg, Edward N. Method and means for testing aqueous solutions for presence of protein. U. S. patent 2,862,796. Filed July 20, 1953. 6 claims. [Cl. 23-230.] An impregnated filter paper is used as the testing device.

Gorton, Thomas S., Jr. Frozen food package. U. S. patent 2,862,823. Filed March 14, 1956. 2 claims. [Cl. 99-195.] Frozen fish fillets are packed within a paperboard carton so as to prevent relative movement of the carton contents.

Hellen, Harold H. von der. Symbol corresponding device for children. U. S. patent 2,862,309. Filed May 18, 1956. 4 claims. [Cl. 35-35.] A paperboard punch-sheet device is provided to enable children to write "letters" by means of symbols.

James, Bill Y. Ornamental bow and blank of components thereof. U. S. patent 2,862,321. Filed June 25, 1956. 5 claims. [Cl. 41-10.] A decorative package bow and fastening device are formed from a paper blank.

Jones, Dwight E. Bladed bodies. U. S. patent 2,862,424. Filed Aug. 12, 1955. 4 claims. Assigned to E. D. Jones & Sons Co. [Cl. 92-27.] Improved means are provided for mounting the blades in a jordan engine plug.

Kaczanowski, Leonard. Oil check towel. U. S. patent 2,862,219. Filed Oct. 18, 1955. 1 claim. [Cl. 15-131.] The

towel comprises a folded sheet of absorbent paper to which is attached a small envelope containing a few drops of clean engine oil.

Kalwaites, Frank. Method of and apparatus for producing nonwoven product. U. S. patent 2,862,251. Filed Feb. 23, 1956. 77 claims. Assigned to Chicopee Mfg. Corp. [Cl. 19-161.] Spaced water streams are passed through a nonwoven fiber web to produce a patterning effect.

Kise, Mearl A., Barton, Robert W., and Ingwall, Robert H. Oxidative-reductive multistage bleaching of ground wood pulp. U. S. patent 2,862,784. Filed March 4, 1955. 5 claims. Assigned to Virginia Smelting Co. [Cl. 8-104.]

Klemka, Albert J., and Pike, Charles O. Pressure-sensitive adhesive tapes. U. S. patent 2,862,613. Filed Oct 20, 1955. 7 claims. Assigned to Norton Co. [Cl. 206-59.] Migration of the release agent from backsize coatings is prevented.

Labombarde, Philip D. Machine and method for feeding sheets. U. S. patent 2,862,709. Filed March 16, 1955. 12 claims. [Cl. 271-32.] Improved sheet separation means are provided in a bottom-feed magazine mechanism for feeding blanks to a machine making folding boxes.

Larson, Robert W. Pulpwood grapple. U. S. patent 2,862,756. Filed May 31, 1955. 2 claims. [Cl. 294-88.]

Lederman, Burton E. Epoxy wrinkle on rubber impregnated paper. U. S. patent 2,862,835. Filed Feb. 17, 1956. 10 claims. Assigned to Commonwealth Engineering Co. of Ohio. [Cl. 117-41.]

Norton, James A. Apparatus and method for corrugating resin-impregnated sheet material. U. S. patent 2,862,542. Filed Aug. 24, 1955. 6 claims. Assigned to General Motors Corp. [Cl. 154-30.] An improved apparatus corrugates treated filter paper for use in engine oil filters.

Poidomani, Catherine, and Armenia, Giuseppe. Combination cigarette and match case. U. S. patent 2,862,611. Filed Nov. 22, 1957. 3 claims. [Cl. 206-48.] A small hinged lid dispensing carton is provided for cigarettes and matches.

Shepherd, Ridgley G., Jr. Heat transfer. U. S. patent 2,862,832. Filed Jan. 9, 1956. 6 claims. Assigned to Dennison Mfg. Co. [Cl. 117-3.2.] A heat transfer comprises a paper backing, a wax coating on one side of the backing, and a printed design on the coating.

Smith, Robert E. Reinforced plastic article. U. S. patent 2,862,524. Filed Oct. 5, 1954. 11 claims. Assigned to Johns-Manville Corp. [Cl. 138-76.] A resin-impregnated asbestos-glass fiber felt is formed into a pipe.

Sparrow, Donald B., and Powers, William R. Method of making sodium cellulose sulphate. U. S. patent 2,862,922. Filed July 20, 1954. 4 claims. Assigned to Scott Paper Co. [Cl. 260-215.]

Stiles, John W. Carton unloader. U. S. patent 2,862,633. Filed Nov. 15, 1955. 16 claims. [Cl. 214-309.]

Stokes, Edward A. Filter elements. U. S. patent 2,862,624. Filed April 26, 1955. 2 claims. Assigned to Vokes, Ltd. [Cl. 210-493.] An improved pleated paper filter element is described.

Swaim, Marvin W., and Le Brell, John. Method of reinforcing box blank. U. S. patent 2,862,425. Filed Oct. 12, 1953. Issued Dec. 2, 1958. 1 claim. Assigned to Alton Box Board Co. [Cl. 93-36.] Reinforced corners are provided in a conventional shoebox lid.

Voysey, Ronald G. Sheet transfer apparatus. U. S. patent 2,862,707. Filed Nov. 29, 1955. 3 claims. Assigned to Peter Carmichael and Co., Ltd. [Cl. 271-3.] Improved vacuum control means are provided in an envelope machine using a series of vacuum cylinders for feeding blanks.

West, Fred W. Compositions of polymers of perhalogenated olefins and wax. U. S. patent 2,862,899. Filed March 29, 1955. 17 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 260-28.5.] The compositions are of use in waterproofing paper.

Wheeler, Donald H. Purification of fatty acids. U. S. patent 2,862,943. Filed Oct. 7, 1954. 7 claims. Assigned to General Mills, Inc. [Cl. 260-419.] Tall oil fatty acids are distilled in the presence of boric acid to improve color characteristics.

### Dec. 9, 1958

Aldington, Elmer T. Apparatus for truncating cups. U. S. patent 2,863,366. Filed Nov. 22, 1955. 1 claim. Assigned to American Can Co. [Cl. 93-36.1.] The machine evenly blunts the bottom of a conical paper cup.

Anderson, Ralph F., and Heifetz, Marvin. Cup filler and capper. U. S. patent 2,863,271. Filed Nov. 17, 1956. 20 claims. [Cl. 53-276.] The machine fills paper cups with ice cream and a topping syrup, then applies a cover.

Ball, John C., Jr. Inhibition of corrosion of iron in acids. U. S. patent 2,863,780. Filed March 4, 1957. 10 claims. Assigned to West Virginia Pulp and Paper Co. [Cl. 106-14.] A lignin derivative is used.

Buckley, John L., and Buckley, Lawrence G. Embossing hardboard. U. S. patent 2,863,168. Filed July 20, 1953. 9 claims. [Cl. 18-10.]

Clark, James d'A. Apparatus for producing fibrous elements. U. S. patent 2,863,476. Filed Oct. 2, 1953. 8 claims. Assigned to Changewood Corp. [Cl. 144-172.] Tapered-edge wafers for use in wood-particle board are produced.

Crane, Walton B. Setup machine. U. S. patent 2,863,369. Filed March 7, 1957. 12 claims. Assigned to Allied Plastics Co. [Cl. 93-37.] The machine sets up a corrugated blank to form an open top crate designed to receive a number of stand-size berry boxes.

Currie, Grover C. Carton for cylindrical objects. U. S. patent 2,863,598. Filed May 4, 1953. 2 claims. Assigned to Dacam Corp. [Cl. 229-52.] A handled tubular sixpack can carrier is provided.

Dorfman, Oskar. Box forming machine. U. S. patent 2,863,370. Filed May 25, 1955. 7 claims. Assigned to Federal Carton Corp. [Cl. 93-49.] The one-piece carton formed is of the type having a hinged cover with partially telescoping flaps.

Emery, Richard L. Molded pulp packaging members. U. S. patent 2,863,595. Filed Nov. 23, 1953. 3 claims. Assigned to Keyes Fibre Co. [Cl. 229-2.5.] A molded pulp interior packing element is provided for use in packaging clocks or other large items.

Fiehl, Michael. Sheet feeding and handling device. U. S. patent 2,863,662. Filed Oct. 12, 1956. 20 claims. Assigned to International Business Machines Corp. [Cl. 271-61.] An auxiliary storage magazine and improved feeding means are provided in a card-feeding apparatus.

Foley, Edward A., and Detko, George J. Sheet handling apparatus. U. S. patent 2,863,571. Filed Oct. 2, 1953. 7 claims. Assigned to Masonite Corp. [Cl. 214-1.] The apparatus transfers hardboard sheets from a horizontal stacked position to frames which support them in vertical spaced parallel relation.

Goldman, Maurice A. Wiping cloth and the manufacture thereof. U. S. patent 2,863,715. Filed Sept. 11, 1952. 9 claims. Assigned to Fibre Products Laboratories, Inc. [Cl. 8-115.6.] This is an industrial wiper formed from cotton and wood pulp fibers.

Harrison, Henry. Fiberboard container. U. S. patent 2,863,596. Filed Aug. 18, 1953. 5 claims. Assigned to Greif Bros. Cooperage Corp. [Cl. 229-23.] A collapsible bulk nail shipper is formed of wood-reinforced multiwall corrugated board.

Holstebroe, Kaye B., and Lippincott, Leander H. Machines for packing containers in cases. U. S. patent 2,863,268. Filed Aug. 15, 1955. 12 claims. Assigned to Emhart Mfg. Co. [Cl. 53-62.] The machine cases flat-top paperboard milk cartons.

Labino, Dominick. Process of producing mats of glass fibers. U. S. patent 2,863,176. Filed April 7, 1954. 14 claims. Assigned to L. O. F. Glass Fibers Co. [Cl. 19-156.]

Lau, Erwin M. Bag settling device. U. S. patent 2,863,475. Filed May 14, 1954. 3 claims. Assigned to Black Products Co. [Cl. 141-77.]

Ledall, Tore B. Ignition compositions for matches, striking surfaces, and the like. U. S. patent 2,863,751. Filed July 28, 1955. 3 claims. [Cl. 52-27.] Ammonium-base spent sulphite liquor is used.

Leibrook, Walton V., and Fasold, George A. Asghalt shingle with sealing elements. U. S. patent 2,863,405. Filed Jan. 17, 1957. 4 claims. Assigned to Philip Carey Mfg. Co. [Cl. 108-7.] A rubber latex-impregnated paper strip is used to prevent premature adhesion of the self-sealing shingles.

Moore, George A. Air extractor and sealing device. U. S. patent 2,863,267. Filed Aug. 14, 1956. 14 claims. [Cl. 53-22.] The machine evacuates and heat-seals envelopes, bags, carton liners, etc.

Moore, George A. Air extractor device. U. S. patent 2,863,266. Filed July 27, 1956. 15 claims. [Cl. 53-22.] This is similar to U. S. patent 2,863,267 (Dec. 8, 1958).

Rapson, William H. Chlorine dioxide production. U. S. patent 2,863,722. Filed March 8, 1955. 4 claims. Assigned to Hooker Chemical Corp. [Cl. 23-152.]

Richards, Augustus J. Delivery end mechanism. U. S. patent 2,863,663. Filed Dec. 1, 1955. 4 claims. Assigned to Bonnar-Vawter, Inc. [Cl. 271-69.] Improved cutting, feeding, and stacking means are provided in the delivery mechanism of a manifold form-producing machine.

Rosenquist, John H., and Westling, Anders W. Process for manufacturing form board for casting concrete. U. S. patent 2,863,364. Filed Jan. 21, 1955. 6 claims. Assigned to Aktiebolaget Statens Skogsindustrier. [Cl. 92-40.] The board is impregnated with an oil such as tall oil and provided with a thermosetting resin covering.

Sorgi, Jim. Pyrotechnic device. U. S. patent 2,863,741. Filed March 31, 1951. 5 claims. [Cl. 44-40.] A tubular paperboard container is employed in forming a self-igniting pyrotechnic device.

Stein, Elmer L. Display mounting. U. S. patent 2,863,236. Filed May 15, 1957. 5 claims. Assigned to Eye-Beam Displays, Inc. [Cl. 40-4.] A paperboard tube fits over the top of a bottle and supports a display panel.

Strine, Philip C. Reinforced corrugated paperboard container and joint therefor. U. S. patent 2,863,597. Filed Aug. 10,

1956. 3 claims. Assigned to International Paper Co. [Cl. 229-47.] An improved jointing method is provided in forming containers of corrugated board having steel strap reinforcements included within the plies.

Theodosopoulos, James, and Zack, Albert. Electric coil manufacture. U. S. patent 2,863,796. Filed April 15, 1955. 6 claims. Assigned to Sylvania Electric Products Inc. [Cl. 154-80.] A mylar-paper combination is used in an electrical coil.

Thiem, Eugene T. Coneecup machine. U. S. patent 2,863,-367. Filed Jan. 10, 1955. 9 claims. Assigned to Continental Can Co., Inc. [Cl. 93-36.2.] The machine forms conical paper cups, reinforces the apex of the cone, and spin-rolls a rim on the cup edge.

Thiem, Eugene T. Cone cup machine. U. S. patent 2,863,-368. Filed March 2, 1955. 6 claims. Assigned to Continental Can Co., Inc. [Cl. 93-36.2.] This is similar to U. S. patent 2,863,367 (Dec. 9, 1958).

Tonna, Arthur J. Carton blank unfolding machine. U. S. patent 2,863,371. Filed April 14, 1958. 9 claims. Assigned to Burgermeister Brewing Corp. [Cl. 93-53.]

Wallace, Burgess, P., Romney, Van D., and Becker, Heinz H. Binders for foundry molds and cores. U. S. patent 2,863,781. Filed May 5, 1955. 6 claims. Assigned to Whitehead Brothers Co. [Cl. 106-38.8.] Spent sulphite liquor is used.

Whitman, Harlan M. Banking envelope. U. S. patent 2,863,599. Filed March 26, 1956. 2 claims. Assigned to Curtis 1000, Inc. [Cl. 229-72.]

Winters, Thomas F., and Lavin, James J. Packet construction. U. S. patent 2,863,463. Filed Nov. 2, 1955. 2 claims. [Cl. 132-73.5.] An otherwise conventional paper match packet contains manicure elements.

**Dec. 16, 1958**

Ahlborg, Knut, and Cederquist, Karl N. Method for recovering sulphur and alkali from waste liquors. U. S. patent 2,864,669. Filed Nov. 1, 1954. 13 claims. Assigned to Stora Kopparbergs Bergslags Aktiebolag. [Cl. 23-131.] Sulphite liquor regeneration is accomplished with the inhibition of thiosulphate formation.

Aldington, Elmer T. Cover for paper containers. U. S. patent 2,864,546. Filed Nov. 7, 1955. 10 claims. Assigned to American Can Co. [Cl. 229-43.] A paper cup-type container is provided with a cover element which completely embraces the rolled rim of the container mouth.

Backlert, Bror, Lanne, Bengt, and Wallin, Sven. Web-guiding apparatus. U. S. patent 2,864,176. Filed April 4, 1957. 6 claims. Assigned to Aktiebolaget Svenska Flakfabriken. [Cl. 34-122.] The apparatus threads a web of paper or other material through a drier or the like.

Brace, George A. Disposable filter bag for suction cleaners. U. S. patent 2,864,462. Filed May 7, 1954. 6 claims. Assigned to Hoover Co. [Cl. 183-51.]

Bruce, John K. Packaging method and apparatus. U. S. patent 2,864,212. Filed May 31, 1955. 55 claims. Assigned to Bruce Engineering Corp. [Cl. 53-3.] A six-pack can package is formed.

Cornwell, Ralph T. K. Resinous film-forming composition and regenerated cellulose film coated therewith. U. S. patent 2,864,783. Filed April 24, 1956. 11 claims. Assigned to American Viscose Corp. [Cl. 260-28.5.] Also of use in coating paper, the composition provides slip, heat-sealability, and resistance to blocking.

Curtenius, Frederick B. Paper trimmers with power ejecting means. U. S. patent 2,864,447. Filed April 2, 1956. 10 claims. Assigned to Rice Barton Corp. [Cl. 164-59.]

Dalton, William L. Knockdown shipping container. U. S. patent 2,864,524. Filed Sept. 22, 1955. 5 claims. [Cl. 217-12.] Improved corner-locking means are provided in a knockdown shipping container formed of panels comprised of wood cleat-reinforced paperboard.

Dedmon, James F. Wirebound cleated plywood or corrugated fiber box. U. S. patent 2,864,523. Filed July 7, 1954. 3 claims. [Cl. 217-12.]

Dellinger, Orville L., and Scott, Franklin D. Paper cup machine blank feeding mechanism. U. S. patent 2,864,612. Filed May 22, 1953. 9 claims. Assigned to Continental Can Co. [Cl. 271-32.]

Doughty, Joseph B., and Cook, William R. Methods of treating pulp mill alkaline bleach effluents. U. S. patent 2,864,811. Filed Nov. 5, 1956. 5 claims. Assigned to West Virginia Pulp and Paper Co. [Cl. 260-124.] The chlorinated lignin is recovered.

Dungler, Julien. Bleaching method. U. S. patent 2,864,662. Filed May 23, 1955. 9 claims. [Cl. 8-108.] Pulp or paper is impregnated with formic or phosphoric acid, contacted with a chlorite bleach, and heated to effect bleaching.

Eberhardt, Lee E., and Woodruff, Maurice D. Plural stage disk mill with back pressure control means for each stage. U. S. patent 2,864,562. Filed May 20, 1953. 6 claims. Assigned to Bauer Bros. Co. [Cl. 241-160.]

Engleson, Harry E., and Sramek, Elmer D. Carton expanding and transfer mechanism. U. S. patent 2,864,288. Filed March 30, 1956. 15 claims. Assigned to F. B. Redington Co. [Cl. 93-53.]

Fink, William C., Lynn, Philip F., and Nordstrom, Magnus. Method of and apparatus for preparation of highly flammable mixtures. U. S. patent 2,864,678. Filed April 27, 1956. 7 claims. Assigned to Sylvania Electric Products Inc. [Cl. 52-19.] Cellulose nitrate is employed in making photo flash bulbs.

Fluck, Linton A., Cooke, Theodore F., and Roth, Philip B. Acid resistant cellulosic material and process for producing same. U. S. patent 2,864,723. Filed Aug. 23, 1956. 15 claims. Assigned to American Cyanamid Co. [Cl. 117-76.]

Ganz, Daniel M. Tape dispensing device. U. S. patent 2,864,496. Filed June 12, 1957. 5 claims. [Cl. 206-59.]

Glab, William T. Methods of making a lignocellulose product and products resulting therefrom. U. S. patent 2,864,715. Filed July 15, 1954. 13 claims. Assigned to Carr, Adams & Collier Co. [Cl. 106-163.] A moldable extrudable composition is formed by reacting wood waste with sulphur and ammonium hydroxide in the absence of water and in the presence of steam.

Guyer, Reynolds. Reclosable carton. U. S. patent 2,864,547. Filed Oct. 18, 1954. 4 claims. Assigned to Waldorf Paper Products Co. [Cl. 229-51.]

Hardy, Walter L. Packaged food product and wrapper therefor, which prevents the destruction of riboflavin in foods. U. S. patent 2,864,709. Filed Nov. 15, 1954. 10 claims. Assigned to Waxed Paper Merchandising Council, Inc. [Cl. 99-171.] The paper wrapper was coated with wax containing perylene or other light-filtering material.

Hermanson, William A., and Hermanson, Gerald I. Moldable absorbent material. U. S. patent 2,864,362. Filed Dec. 1, 1953. 5 claims. [Cl. 128-156.] A medical dressing comprises several plies of different types of paper.

Holcombe, Harold N. Dispensing containers. U. S. patent 2,864,493. Filed Sept. 4, 1957. 3 claims. Assigned to Eastern Box Co. [Cl. 206-52.] A paperboard carton is provided for dispensing a rolled web of wire mesh material.

Hurst, George. Sun hat. U. S. patent 2,864,092. Filed April 3, 1956. 1 claim. [Cl. 2-177.] A collapsibl econical hat is formed from a pleated sheet of paper.

Johnson, Al, and Gauger, Fred. Machine for folding and locking carton blanks. U. S. patent 2,864,287. Filed May 19, 1955. 1 claim. Assigned to Valley Pattern & Mfg. Co. [Cl. 93-51.]

Kass, Seymour G. Collar stay for shirts and other garments. U. S. patent 2,864,540. Filed July 18, 1957. 1 claim. [Cl. 223-83.] The stay is formed from a paperboard blank.

Keim, Gerald I. Coated film and method of making same. U. S. patent 2,864,724. Filed Sept. 21, 1956. 6 claims. Assigned to Hercules Powder Co. [Cl. 117-76.] An anchoring coating is provided for use in coating regenerated cellulose film with a water-repellent top coat.

Knisely, James D. Bag handling and filling machine. U. S. patent 2,864,219. Filed Oct. 28, 1957. 4 claims. Assigned 50% to James Keith Payne. [Cl. 53-187.]

Le Bihan, Henri, Godart, Jean A. R., and Burton, Raymond A. Process of preparing urea-formaldehyde molding powders. U. S. patent 2,864,779. Filed July 25, 1956. 3 claims. Assigned to Societe Belge de L'Azote et des Produits Chimiques du Marly, SA. [Cl. 260-17.3.] Pulverized paper is used as filler.

Maguire, Richard G., and Hedrick, Glen W. Transfer sheet coated with a composition containing a salta nd a hydrotrope. U. S. patent 2,864,720. Filed Oct. 29, 1954. 3 claims. Assigned to Ditto, Inc. [Cl. 117-36.] A carbon paper is provided for use in spirit duplicating processes.

Mones, Arthur H. Facsimile recording paper. U. S. patent 2,864,748. Filed Aug. 27, 1956. 5 claims. Assigned to Faximile, Inc. [Cl. 204-2.] An electro-sensitive recording paper comprises a wet-strength paper impregnated with an electrolyte and salicylaldoxime as a marking compound.

Nyden, Robert. Receptacles. U. S. patent 2,864,533. Filed Jan. 31, 1956. 9 claims. [Cl. 221-260.] A paperboard container comprises an outer casing and an article carrier slidable within the casing.

Podgorski, Walter F. Method and apparatus for packaging. U. S. patent 2,864,217. Filed Jan. 10, 1958. 5 claims. Assigned to P. Ballantine & Sons. [Cl. 53-123.] The machine forms and fills two 3-pack can carriers from one 6-pack carrier blank.

Proffen, Hermann. Apparatus for interrupting the formation of transverse rents in paper webs. U. S. patent 2,864,284. Filed March 25, 1953. 15 claims. [Cl. 92-38.] This is a photocell-jet cutter apparatus for use on the paper machine.

Rawson, Edward R., and Whalen, Douglas E. Apparatus for making dry cells. U. S. patent 2,864,286. Filed Oct. 28, 1953. 10 claims. Assigned to Burgess Battery Co. [Cl. 93-36.01.] Means are provided for lining the anode cup of a flashlight battery with paper.

Ritchie, John A. Paper product roll dispenser. U. S. patent

2,864,495. Filed March 12, 1956. 3 claims. [Cl. 206-58.] A round dispensing aperture is used in a carton for a supply roll of paper towels or the like.

Roselius, Louis W. Taping machine. U. S. patent 2,864,285. Filed May 24, 1954. 5 claims. Assigned to S & S Corrugated Paper Machinery Co., Inc. [Cl. 93-1.] Tear tape is applied to a corrugated box blank.

Royce, Mark B. Shipping container for fruits, vegetables and other articles. U. S. patent 2,864,545. Filed July 31, 1957. 7 claims. Assigned to Continental Can Co., Inc. [Cl. 229-23.] The telescoping-cover container is formed from corrugated board reinforced with wood veneer.

Ruscetta, Ralph A., and Dalton, Raymond N. Electric capacitor. U. S. patent 2,864,982. Filed Dec. 17, 1952. 5 claims. Assigned to General Electric Co. [Cl. 317-258.] Kraft or linen paper is used in forming the dielectric spacer elements.

Schmalz, Alfred C. Stabilized paste rosin size. U. S. patent 2,864,716. Filed July 26, 1957. 6 claims. Assigned to Hercules Powder Co. [Cl. 106-238.]

Tuthill, Howard B. Labeling machine. U. S. patent 2,864,522. Filed May 7, 1956. 12 claims. Assigned to Oliver Machinery Co. [Cl. 216-29.] The machine labels small bottles with labels cut from a supply roll.

Wilson, James S., Perman, Douglas V., Hansen, H. H., Broyles, Horace N., Evans, George W., Pavoni, Paul, and Kindel, William H. Packing apparatus. U. S. patent 2,864,218. Filed Oct. 31, 1955. 19 claims. Assigned to Mechanical Products, Inc. [Cl. 53-124.] A mattress is packed into a paper bag.

Zastrow, Harold G. Bottle carrier. U. S. patent 2,864,531. Filed Jan. 21, 1955. 4 claims. Assigned to Waldorf Paper Products Co. [Cl. 220-105.]

Zastrow, Harold G. Easy opening container construction. U. S. patent 2,864,548. Filed Oct. 18, 1954. 1 claim. Assigned to Waldorf Paper Products Co. [Cl. 229-51.] A tear strip separates a corrugated carton into two vertical sections.

**Dec. 23, 1958**

Alford, Gilbert H. Inverter for printed sheets. U. S. patent 2,865,517. Filed Oct. 26, 1954. 2 claims. Assigned to Wm. Hollingsworth Machine Co., Inc. [Cl. 214-1.] The delivery end of a printing press is provided with a mechanism which receives printed sheets, aligns and stacks them, then inverts the stack.

Asten, Dietrich V. Dryer felt for fine quality paper. U. S. patent 2,865,409. Filed June 27, 1955. 9 claims. [Cl. 139-426.]

Baer, Carl A. Method of treating fibrous material utilizing a radio-frequency field which extends predominantly at right angles to the length of said material. U. S. patent 2,865,790. Filed Aug. 19, 1955. 2 claims. [Cl. 117-93.] The radio field improves the dispersion of binder in a nonwoven web, then sets the binder.

Batdorf, Jack B. Method of reducing B.O.D. of starch bearing effluent by addition of substituted starch to effluent. U. S. patent 2,865,853. Filed June 16, 1955. 3 claims. Assigned to Hercules Powder Co. [Cl. 210-59.]

Bergstein, Frank D. Containers having strong end closures and methods of making them. U. S. patent 2,865,550. Filed March 8, 1954. 8 claims. Assigned to Bergstein Packaging Trust. [Cl. 229-17.] Improved end closures are provided in flat-top paperboard milk cartons.

Bloom, Roy C., and Fassbender, Henry J. Tinting bath for photographic paper. U. S. patent 2,865,746. Filed April 5, 1956. 2 claims. Assigned to Eastman Kodak C. [Cl. 96-48.] Lignosulphonates are used.

Bulloff, Jack J. Solidified air odor control liquids. U. S. patent 2,865,806. Filed Aug. 5, 1955. 21 claims. Assigned to Interstate Sanitation Co., Inc. [Cl. 167-42.] Ethylcellulose is used.

Coyne, William R. Insert feeding apparatus. U. S. patent 2,865,154. Filed June 20, 1955. 11 claims. Assigned to Pillsbury Co. [Cl. 53-59.] Coupons are inserted into containers.

Crowe, John H. Iron ore briquette with paper pulp binder. U. S. patent 2,865,731. Filed June 25, 1954. 13 claims. Assigned to Minerals & Chemicals Corp. of America. [Cl. 75-3.]

Fradenburgh, John. Feeder cut-out for box making machine. U. S. patent 2,865,262. Filed March 31, 1954. 1 claim. Assigned to United States Automatic Box Machinery Co. [Cl. 93-36.]

Fritts, Wilfred G. Slab debarker having bark-abrading elements mounted on rotatable resilient disk. U. S. patent 2,865,414. Filed March 28, 1957. 4 claims. [Cl. 144-208.]

Gary, Glen G. Reduced curl in photographic paper. U. S. patent 2,865,792. Filed Dec. 20, 1954. 6 claims. Assigned to Eastman Kodak Co. [Cl. 117-143.] The paper is impregnated with an ethylene glycol diethyl ether.

Hagemeyer, Hugh J., Jr., and Oglesby, Elizabeth L. Graft copolymers of acrylonitrile and another ethenoid monomer with a hydroxyl-containing cellulose derivative and their preparation. U. S. patent 2,865,872. Filed Oct. 22, 1954. 8 claims. Assigned to Eastman Kodak Co. [Cl. 260-17.] Ethylcellulose, cellulose acetate, and other cellulose derivatives are used in preparing a fiber- and film-forming composition.

Henderson, Charles L., and Fitzgerald, Harry G. Nonwoven web product and method of making same. U. S. patent 2,865,783. Filed Oct. 30, 1952. 14 claims. Assigned to Kimberly-Clark Corp. [Cl. 117-5.5.]

Hiatt, Gordon D., and Emerson, John. Preparation of salts of dicarboxylic acid esters. U. S. patent 2,865,898. Filed Aug. 24, 1955. 10 claims. Assigned to Eastman Kodak Co. [Cl. 260-78.4.] Salts of cellulose acetate phthalate or other cellulose esters are prepared.

Höye, John. Process for the fractionating of sulphite lye. U. S. patent 2,865,906. Filed Dec. 19, 1955. 12 claims. Assigned to Aktieselskabet Token Cellulosefabrik. [Cl. 260-124.]

Hotten, Bruce W. Alkyl, hydroxyalkyl cellulose grease. U. S. patent 2,865,858. Filed May 25, 1956. 5 claims. Assigned to California Research Corp. [Cl. 252-52.] The lubricant is suitable for use in paper machine roller bearings.

Inman, William H. Carton. U. S. patent 2,865,549. Filed Feb. 7, 1958. 6 claims. Assigned to Bloomer Bros. Co. [Cl. 229-16.] The carton has an inner tray die-cut to receive articles held in individual cups.

Jacke, Raymond E. Package for crackers and the like. U. S. patent 2,865,769. Filed July 23, 1954. 1 claim. Assigned to Reynolds Metals Co. [Cl. 99-172.] The package includes an inner layer of creped or corrugated paper and an outer layer of a laminated waxed paper-aluminum foil-tissue paper.

Johnson, Joyce L., Booth, Arthur, and Messmer, Ernest. Oil in water emulsion textile printing paste and preparation. U. S. patent 2,865,871. Filed March 16. 1954. 4 claims. Assigned to Interchemical Corp. [Cl. 260-15.] Ethyl- and methylcellulose are used.

Kampmeyer, Preston M., and Hendrickson, Thomas C. Plasticizers for coated cellophane. U. S. patent 2,865,774. Filek Aug. 2, 1956. 7 claims. Assigned to Olin Mathieson Chemical Corp. [Cl. 106-178.]

Lee, Charles A. Flow control apparatus. U. S. patent 2,865,260. Filed Sept. 22, 1953. 19 claims. Assigned to Kimberly-Clark Corp. [Cl. 92-44.] A fourdrinier machine flow spreader is provided.

Messner, Daryle. Protective cover for the neck of a television picture tube or the like. U. S. patent 2,866,188. Filed Aug. 23, 1955. 4 claims. Assigned to Hoffman Electronics Corp. [Cl. 340-367.] The cover is set up from a paperboard blank.

Moser, Henry W. Drive mechanism for triplex slitter-scorers. U. S. patent 2,865,264. Filed Feb. 13, 1957. 3 claims. Assigned to Samuel M. Langston Co. [Cl. 93-58.2]

Nydegger, George C. Apparatus for folding sheets and inserting them in envelopes. U. S. patent 2,865,155. Filed Nov. 12, 1954. 10 claims. [Cl. 53-117.]

Phillips, Henry F. Die structure and method of making same. U. S. patent 2,865,235. Filed March 1, 1954. 3 claims. Assigned to Flo-Seal Corp. [Cl. 76-107.] An improved method is provided for forming the die used in cutting the pouring spout elements in a paper-board dispensing carton.

Pinder, Raymond G. Lacquer composition comprising epoxide resin, polyamide resin, and cellulose acetate butyrate and article coated therewith. U. S. patent 2,865,870. Filed Oct. 24, 1955. 4 claims. Assigned to Eastman Kodak Co. [Cl. 260-13.]

Rasmussen, John P. Carton. U. S. patent 2,865,551. Filed July 12, 1957. 2 claims. [Cl. 229-28.] This is a small partitioned film-overwrapped display shipper for glassware.

Repking, Edward F., and Willett, Howard D. One-piece beverage shipping case. U. S. patent 2,865,554. Filed Feb. 7, 1955. 4 claims. Assigned to Crown Zellerbach Corp. [Cl. 229-44.]

Ringler, William A. Paperboard tobacco pouch. U. S. patent 2,865,498. Filed March 13, 1956. 5 claims. Assigned to Diamond Match Co. [Cl. 206-41.1.]

Ross, Sidney D. Electrolytic capacitor. U. S. patent 2,866,139. Filed Oct. 22, 1953. 3 claims. Assigned to Sprague Electric Co. [Cl. 317-230.] The dielectric spacer used comprises paper impregnated with a salt of quinonoid acid.

Schroeder, John B. Polishing article. U. S. patent 2,865,725. Filed June 18, 1956. 3 claims. Assigned to Econ-O-Cloth. [Cl. 51-303.] Cellulose nitrate is used in forming a cotton-base lens polishing material.

Schroeder, Williard F. Process of bleaching kraft pulp with alkaline hypochlorite bleach, acidifying the pulp containing residual chlorine and then bleaching with alkaline peroxide. U. S. patent 2,865,701. Filed Dec. 7, 1953. 2 claims. Assigned to National Distillers and Chemical Corp. [Cl. 8-106.]

Seragnoli, Ariosto. Mechanism to produce a tear-strip and to secure it to a wrapper. U. S. patent 2,865,261. Filed March 24, 1955. 1 claim. [Cl. 93-1.]

Sherman, Whitney D. Manufacture of paperboard hat box bodies and cover flanges. U. S. patent 2,865,265. Filed June 24, 1955. 4 claims. Assigned to Continental Can Co., Inc. [Cl. 93-77.]

Sider, Nicholas M., and Williamson, Oscar H. Separable ship-

ping container. U. S. patent 2,865,552. Filed June 2, 1953. 1 claim. Assigned to International Paper Co. [Cl. 229-37.] This is a corrugated telescoping lid shipper for loose nuts and bolts.

Stewart, Charles L. Molded pulp container with tear strip. U. S. patent 2,865,548. Filed Nov. 4, 1955. 2 claims. Assigned to Keyes Fibre Co. [Cl. 229-2.5.]

Stone, Orison W. Boxboard container. U. S. patent 2,865,-555. Filed Feb. 28, 1958. 12 claims. Assigned to Lassiter Corp. [Cl. 229-51.] The upper portion breaks away and swings back in the manner of a hinged lid for display purposes.

Strand, Clifford A. Apparatus for making glued corrugated cartons. U. S. patent 2,865,263. Filed Sept. 28, 1956. 3 claims Assigned to International Paper Box Machine Co. [Cl. 93-51.]

Sweet, Walter J. Method of reducing B.O.D. of starch bearing effluent by addition of substituted cellulose to effluent. U. S. patent 2,865,854. Filed June 16, 1955. 3 claims. Assigned to Hercules Powder Co. [Cl. 210-59.]

Van Dyke, Arthur W. Molded pulp carton. U. S. patent 2,865,547. Filed Jan. 19, 1954. 6 claims. Assigned to Diamond Gardner Corp. [Cl. 229-2.5.]

Vollrath, Richard. Corrugator double-backer blanket. U. S. patent 2,865,408. Filed Nov. 15, 1955. 5 claims. Assigned to Victor Balata & Textile Belting Co. [Cl. 139-408.]

Wasyluka, Paul. Reinforcing and cover supporting device for a container. U. S. patent 2,865,553. Filed Dec. 30, 1954. 1 claim. Assigned to Crown Zellerbach Corp. [Cl. 229-37.] This is a split-cover bottle case.

Weisgerber, Cyrus A. Ketene dimer sizing composition and process for sizing paper therewith. U. S. patent 2,865,743. Filed March 11, 1957. 12 claims. Assigned to Hercules Powder Co. [Cl. 92-3.]

Wells, Archcibald H., Nissan, Alfred H., Highton, Allan P., and Hopkins, Leonard F. Gloss meter. U. S. patent 2,866,375. Filed Sept. 28, 1954. 4 claims. Assigned to Bowater Research and Development Co., Ltd. [Cl. 88-14.] This is a photoelectric apparatus for determining the gloss of a sheet of paper.

Williams, Russell J. Bag. U. S. patent 2,865,556. Filed Jan. 11, 1956. 11 claims. Assigned to Bemis Bro. Bag Co. [Cl. 229-62.5.] Improved valve construction is provided in a multi-ply valve bag.

Windstrup, Robert F., Rose, Edward, and Miller, Nicholas S. Bag header. U. S. patent 2,865,152. Filed April 9, 1956. 16 claims. Assigned to Peters Machinery Co. [Cl. 53-14.]

Zimmerman, Otto H. Book-jacket with a replaceable note-pad. U. S. patent 2,865,659. Filed Nov. 15, 1955. 1 claim. [Cl. 281-31.]

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Alexander, Lester W. Kraft board folding egg case. U. S. patent 2,866,585. Filed Jan. 31, 1957. 1 claim. [Cl. 229-15.]

Avedikian, Souren Z. Manufacture of chlorine dioxide from an alkali metal chlorate and an alkali metal bisulfite. U. S. patent 2,866,683. Filed April 23, 1958. 4 claims. [Cl. 23-152.]

Avedikian, Souren Z. Manufacture of chlorine dioxide from an alkali metal chlorate and an alkali metal nitrite. U. S. patent 2,866,682. Filed April 23, 1958. 4 claims. [Cl. 23-152.]

Bolding, Hubert V. Recessed automatic bottom carton. U. S. patent 2,866,588. Filed March 23, 1955. 3 claims. Assigned to Standard Packaging Corp. [Cl. 229-39.]

Bunzl, Hugo, and Schechner, Paul. Paper tubes. U. S. patent 2,866,465. Filed March 22, 1954. 2 claims. Assigned to Cigarette Components Ltd. [Cl. 131-208.] The tube is of creped paper wrapped in two paper layers, and may be cut into cigarette filters.

Chapman, James R. Overwrapped cigarette carton. U. S. patent 2,866,590. Filed May 15, 1957. 5 claims. Assigned to Reynolds Metals Co. [Cl. 229-51.] The package is designed so that it may be neatly reclosed and resealed after slitting open for application of revenue stamps.

Chase, Richard R., and Bowers, John C. Separating nonacids from soap stocks. U. S. patent 2,866,781. Filed July 11, 1956. 2 claims. Assigned to Union Bag-Camp Paper Corp. [Cl. 260-97.7.] Sterols and other nonacid materials are recovered from tall oil soap stock.

Ciesielski, Leo F., and Albrecht, Hans. Recovery of beta-sitosterol from tall oil pitch by steam distillation. U. S. patent 2,866,739. Filed May 18, 1955. 9 claims. Assigned to American Cyanamid Co. [Cl. 202-46.]

Cote, Omer E. Blank feeder for a box making machine. U. S. patent 2,866,641. Filed Feb. 12, 1954. 4 claims. Assigned to United States Automatic Box Machinery Co. [Cl. 271-44.]

Ford, John L. Single use mold for obround water meter barrels. U. S. patent 2,866,251. Filed July 5, 1956. 6 claims. Assigned to Ford Meter Box Co., Inc. [Cl. 25-118.] The mold is formed from a corrugated board blank.

Ford, John L., and Ford, Richard V. Single use fiber board mold for water meter barrels. U. S. patent 2,866,250. Filed Feb. 11, 1954. 6 claims. Assigned to Ford Meter Box Co., Inc. [Cl. 25-118.] The mold is formed from a corrugated board blank.

Gleim, William K. T., Urban, Peter, and Gatsis, John G. Production of nonstaining antiozonant. U. S. patent 2,866,825. Filed Nov. 19, 1956. 6 claims. Assigned to Universal Oil Products Co. [Cl. 260-613.] Dimethyl ethers of 5-alkyl-pyrogallols are recovered from hardwood tar distillate.

Hanson, Hugo H. Magnesium hydroxide sized photosensitive paper. U. S. patent 2,866,707. Filed Feb. 1, 1955. 7 claims. Assigned to W. C. Hamilton & Sons. [Cl. 96-75.]

Hart, Donald M. Carbon paper inks and method for making same. U. S. patent 2,866,711. Filed March 30, 1956. 9 claims. Assigned to Moore Business Forms, Inc. [Cl. 106-22.]

Hetherington, Alexander C. Dispersion of fluorochlorocarbon polymers in a solution of a copolymer of trifluorochloroethylene with a halogenated olefin and method of coating surface therewith. U. S. patent 2,866,721. Filed March 15, 1955. 15 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl. 117-103.] This is a paper coating composition.

Himelick, Robert E. Therapeutic composition of matter. U. S. patent 2,866,735. Filed March 18, 1954. 15 claims. Assigned to Upjohn Co. [Cl. 167-65.] Carboxymethylcellulose or cellulose acetate phthalate is used.

Kemp, Clayton J. Box folding equipment. U. S. patent 2,866,393. Filed Feb. 3, 1955. 17 claims. [Cl. 93-49.]

Klein, William J., and Dube, Stephen A. Display device. U. S. patent 2,866,544. Filed Nov. 20, 1956. 1 claim. Assigned to Boxmakers, Inc. [Cl. 206-80.] A plastic holder supports a lipstick tube on a paper-board display card.

Körber, Kurt. Method of producing a soft package for cigarettes. U. S. patent 2,866,304. Filed Sept. 26, 1955. 5 claims. Assigned to Kurt Körber & Co. [Cl. 53-14.]

Krueger, Alfred P. Tape-dispensing mechanism. U. S. patent 2,866,502. Filed April 16, 1953. 6 claims. Assigned to Derby Sealers Inc. [Cl. 164-42.] The apparatus dispenses measured lengths of gummed tape for use on cartons and the like.

Long, Florren E. Carton forming unit. U. S. patent 2,866,584. Filed March 21, 1957. 6 claims. Assigned to Continental Can Co., Inc. [Cl. 229-14.] A liquid container is set up from a flattened paperboard tube to the interior of which is fastened a liner bag.

Moore, George A. Paper plastic container with dispensing closure. U. S. patent 2.866,586. Filed March 28, 1957. 15 claims. [Cl. 229-17.] The carton, for liquids and the like, is formed of board coated with a bacteriostatically treated thermoplastic film.

Poppe, George W. Paper bag with locking means through slits. U. S. patent 2,866,591. Filed Oct. 31, 1955. 11 claims. Assigned to Equitable Paper Bag Co., Inc. [Cl. 229-77.]

Ravis, Herbert J. Phonograph record jacket. U. S. patent 2,866,541. Filed Sept. 12, 1956. 1 claim. Assigned to Peerless Album Co., Inc. [Cl. 206-62.]

Rigg, Ernest W. D. Machines for printing and packaging. U. S. patent 2,866,307. Filed Dec. 1, 1953. 2 claims. Assigned to R. B. Production and Engineering Co., Ltd. [Cl. 53-186.] This is a machine for overprinting and assembling a package comprising a tubular carton housing a light-bulb-supporting platform.

Rives, William H. Document feeding machine. U. S. patent 2,866,640. Filed July 20, 1955. 20 claims. Assigned to Universal Business Machines, Inc. [Cl. 271-39.]

Rose, Boyd W. Apparatus for filling bags. U. S. patent 2,866,484. Filed Nov. 1, 1955. 17 claims. Assigned to Food Machinery and Chemical Corp. [Cl. 141-83.] The apparatus fills bags with powdered or granular material.

Scarvelis, Gus S. Pouch manufacturing means and method. U. S. patent 2,866,392. Filed July 25, 1956. 15 claims. Assigned to Continental Can Co., Inc. [Cl. 93-8.] A machine forms a cellophane or glassine pouch for use in packaging food.

Struble, Glenn E. Double-walled box. U. S. patent 2,866,-587. Filed Aug. 23, 1955. 4 claims. Assigned to Diamond Gardner Corp. [Cl. 229-34.] Improved corner-locking means are provided.

Then, Edward O. Carrying device for containers. U. S. patent 2,866,543. Filed Dec. 23, 1955. 4 claims. Assigned to American Can Co. [Cl. 206-65.] This is a paperboard coupling and handle element for two flat-top milk cartons.

Then, Edward O. Carrying device for containers. U. S. patent 2,866,661. Filed Dec. 23, 1955. 8 claims. Assigned to American Can Co. [Cl. 294-87.2.] This is a paperboard coupling and handle device for two flat-top milk cartons.

Watkins, Spencer H. Tall oil rosin sizes stabilized against crystallization and methods of making same. U. S. patent 2,866,782. Filed Sept. 14, 1956. 6 claims. Assigned to Hercules Powder Co. [Cl. 260-105.]

Zacker, Lawrence F. Tear strip for envelopes and other containers. U. S. patent 2,866,589. Filed Dec. 17, 1956. 3 claims. [Cl. 229-51.]

The following patents were received later than those of the same issue date, and have accumulated during the past year.

**March 22, 1955**

Meaders, Robert C. Method of refining inorganic fibrous materials. U. S. patent 2,704,603. Filed Feb. 13, 1952. 2 claims. Assigned to Carborundum Co. [Cl. 209-211.] Mineral fibers are initially refined by aerial methods, then slurried and processed in accordance with papermaking, beating, separating, and sheeting methods.

**Dec. 27, 1955**

Darragh, John L. Stable emulsions of lower molecular weight polybutenes. U. S. patent 2,728,684. Filed Oct. 23, 1951. 3 claims. Assigned to California Research Corp. [Cl. 106-285.] The emulsions are of use in applying water-resistant coatings to multi-ply paper bags.

**April 3, 1956**

Plich, Frank. Pumpable potassium soaps. U. S. patent 2,740,760. Filed July 5, 1952. 7 claims. Assigned to Armour and Co. [Cl. 252-132.] Tall oil is saponified with potassium hydroxide.

**Nov. 6, 1956**

Suen,Tzeng J.,and Jen, Yun. Melamine resins modified with polyalkylene polamine-halohydrin condensates. U. S. patent 2,769,797. Filed July 6, 1955. 12 claims. Assigned to American Cyanamid Co. [Cl. 260-45.2.] The product is a wet-strength agent for paper.

Suen, Tzeng J., and Jen, Yun. Polyamine modified malamine resins. U. S. patent 2,769,799. Filed March 20, 1953. 18 claims. Assigned to American Cyanamid Co. [Cl. 260-67.6.] A wet-strength agent for paper is prepared.

**Nov. 13, 1956**

Grangaard, Donald H., and Plummer, Arthur W. Veneer patching method. U. S. patent 2,770,556. Filed Jan. 22, 1953. 3 claims. Assigned to Kimberly-Clark Corp. [Cl. 117-2.] A mixture of resin and bark or sawdust is deposited by air-deposition methods so as to fill holes in the surface of a sheet of veneer.

**July 16, 1957**

Nickerson, Ralph F. Colloidal silica compositions. U. S. patent 2,799,658. Filed May 2, 1952. 5 claims. Assigned to Monsanto Chemical Co. [Cl. 252-313.] A composition for treating paper to improve tear strength includes colloidal silica, gelatin, and a gelatin preservative.

**July 30, 1957**

Goddard, Harold O. Process of recovering alcohol from waste sulphite liquor. U. S. patent 2,801,206. Filed March 25, 1954. 6 claims. [Cl. 195-39.]

**Aug. 13, 1957**

Weiss, Walter J., and Hall, Wilbur L. Drilling fluid. U. S. patent 2,802,783. Filed July 9, 1956. 29 claims. Assigned to Texas Co. [Cl. 252-8.5.] This is similar to U. S. patent 2,856,-357 (Oct. 14, 1958).

**Aug. 20, 1957**

Kather, William S. Process for rendering calcium-containing masonry water-repellent. U. S. patent 2,803,561. Filed May 27, 1952. 3 claims. Assigned to General Electric Co. [Cl. 117-121.] Masonry, gypsum, cigarette paper, and the like are rendered water-repellent by treatment with a sodium salt of methylsilane-triol.

**Aug. 27, 1957**

Bates, Harold, Fisher, James W., and Upton, Edward J. Treatment of flowable materials. U. S. patent 2,804,457. Filed Nov. 28, 1951. 3 claims. Assigned to British Celanese Ltd. [Cl. 260-227.] A continuous process and apparatus for acetylating (esterifying) cellulose and for ripening and stabilizing the cellulose esters are claimed.

Dreschsel, Erheart, K. Rosin-vinylsilane adducts and polymers thereof. U. S. patent 2,804,439. Filed Nov. 10, 1953. 5 claims. Assigned to American Cyanamid Co. [Cl. 260-27.] The product imparts water-repellency to paper.

Goodman, Robert B. Process for using aluminum hydride to make aluminum metal coated material. U. S. patent 2,804,397. Filed Nov. 16, 1954. 5 claims. Assigned 50% to Paul J. Marks. [Cl. 117-65.] The process described may be used to coat paper with aluminum.

**Sept. 10, 1957**

Drechsel, Erhart K. Polymerization of cyclic carbamates. U. S. patent 2,806,017. Filed Nov. 29, 1955. 5 claims. Assigned to American Cyanamid Co. [Cl. 260-77.5.] Cyclic carbamates are heated to convert them to linear polymers of use in paper treating and other applications.

**Sept. 17, 1957**

Melamed, Sidney. Unsaturated carbamato ethers and thioethers, polymers thereof, and methods of making them. U. S. patent 2,806,838. Filed July 15, 1955. 16 claims. Assigned to Rohm & Haas Co. [Cl. 260-77.5.] The polymers are useful as paper impregnating, coating, and laminating agents, and as wet-strength additives.

**Oct. 8, 1957**

Wenzelberger, Elwood P. Reaction products of dextran-modified polyester with urea-formaldehyde alcohol condensates and method of producing. U. S. patent 2,809,176. Filed Nov. 30, 1954. 17 claims. Assigned to Commonwealth Engineering Co. of Ohio. [Cl. 260-17.3.] The resin produced is useful in applying moisture-resistant coatings to paper.

**Oct. 15, 1957**

Hunter, Edward A., and Small, Augustus B. Process for preparing dispersions of hydrocarbon resins and products obtained thereby. U. S. patent 2,809,948. Filed Aug. 4, 1955. 10 claims. Assigned to Esso Research and Engineering Co. [Cl. 260-28.5.] The dispersion is of use in coating, impregnating, and laminating paper and board.

**Oct 22, 1957**

Beesley, Stanley, John, John A., and Drewitt, James G. N. Beta-sulphonyl ketones. U. S. patent 2,810,728. Filed Oct. 10, 1952. 4 claims. Assigned to British Celanese Ltd. [Cl. 260-332.1.] Sulpholane derivatives are employed as plasticizers for various cellulose derivatives.

Dean, Robert B. Process and composition for improving casein. U. S. patent 2,810,655. Filed Jan. 11, 1954. 2 claims. Assigned to Borden Co. [Cl. 106-146.] Casein and a polyphosphate are mixed in water and subjected to shearing between rollers to form a coating, labeling, and sizing composition for paper.

Melamed, Sidney. Quaternary ammonium compounds and methods of producing them. U. S. patent 2,810,713. Filed March 21, 1955. 17 claims. Assigned to Rohm & Haas Co. [Cl. 260-80.3.] The compounds described are useful as pulp additives where it is necessary to anchor other agents to the fibers.

**Nov. 5, 1957**

Price, John A., and Thomas, Walter M. Copolymers of hydroxynitriles. U. S. patent 2,812,315. Filed Aug. 19, 1954. 4 claims. Assigned to American Cyanamid Co. [Cl. 260-80.5.] The composition provided is of use in various coating, laminating, and paper-treating applications.

**Nov. 12, 1957**

Caldwell, Carlyle G., and Wurzburg, Otto B. Ungelatinized tertiary amino alkyl ethers of amylaceous materials. U. S. patent 2,813,093. Filed June 10, 1953. 7 claims. Assigned to National Starch Products Inc. [Cl. 260-223.3.] The products are useful as beater additives for improving paper strength.

**Nov. 26, 1957**

Stewart, William D., and Wachtel, William L. Cellulose ether processing. U. S. patent 2,814,620. Filed Feb. 24, 1955. 23 claims. Assigned to Atlantic Research Corp. [Cl. 260-232.] A process is described for making small nonporous spherical particles of water-insoluble cellulose ether.

**Dec. 17, 1957**

Melamed, Sidney. Waxy N-vinyloxyalkyl-alkane-carboxamides. U. S. patent 2,816,880. Filed Dec. 8, 1954. 16 claims. Assigned to Rohn & Haas Co. [Cl. 260-77.5.] The compositions are of use as surfactants in the paper industry, and in imparting water-repellent finishes to paper.

**Dec. 24, 1957**

Fraser, George L. Internally plasticized melamine resins and laminates made therewith. U. S. patent 2,817,614. Filed Oct. 26, 1953. 11 claims. Assigned to Monsanto Chemical Co. [Cl. 154-43.] Paper laminates are prepared using a melamine-formaldehyde condensate which has been reacted with an aralkyl guanamine.

Weisgerber, Cyrus A. Reaction of polyvinylphthalimides and alkylene polyamines and products thereof. U. S. patent 2,817,-645. Filed June 30, 1954. 11 claims. Assigned to Hercules

Powder Co. [Cl. 260-78.] The product is of use in wet-strengthening paper and clarifying white water.

### Jan. 21, 1958

Ehrich, Felix F. Production of metal-free phthalocyanines. U. S. patent 2,820,796. Filed July 23, 1954. 8 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-314.5.] The products are of use in paper coloring, printing inks, etc.

### Feb. 4, 1958

Alexander, Paul, Baxter, Alexander S., and Boston, Malcolm E. Vacuum metalizing and apparatus therefor. U. S. patent 2,822,301. Filed June 3, 1952. 13 claims. Assigned to Continental Can Co., Inc. [Cl. 117-217.]

Schalditz, Herman. Metal deposition process. U. S. patent 2,822,292. Filed Dec. 28, 1954. 9 claims. [Cl. 117-107.] A process of metalizing paper or other surfaces is described.

Wohnsiedler, Henry P. Method of preparing triazinyl compositions and products thereof. U. S. patent 2,822,347. Filed June 3, 1955. 19 claims. Assigned to American Cyanamid Co. [Cl. 260-67.6.] Melamine, ethylene chlorohydrin, and pyridine are reacted to form a resin useful id laminating, coating, and impregnating paper.

### Feb. 11, 1958

Clare, Norval D., and Deyrup, Alden J. Flameproofing with alkali metal fluoride and a member of the group consisting of boric acid and anhydride. U. S. patent 2,823,145. Filed March 21, 1956. 22 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 117-138.] Pulp, paper, etc., are flameproofed with sodium oxyfluoborate

Dalton, Richard L. Aluminum complexes and process for preparing the same. U. S. patent 2,823,144. Filed June 7, 1956. 14 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 117-121.] An aluminum salt is reacted with a carboxylic acid to produce a water-repellent coating agent for paper.

Webb, James L. A. Wood treatment. U. S. patent 2,823,159. Filed Dec. 22, 1955. 8 claims. Assigned to Chapman Chemical Co. [Cl. 167-38.7.] Tall oil is used in a wood preservation treatment.

### Feb. 18, 1958

Bostwick, Charles O. Water soluble group IV-A metal esters of amino alcohols and their preparation. U. S. patent 2,824,114. Filed Sept. 9, 1952. 20 claims. Assigned to E. I. du Pont de Nemours & Co. [Cl. 260-429.3.] The product is a surfactant useful in preparing wax emulsions for coating paper.

Zimmerman, Frederick J. Method for the continuous self-sustaining flameless oxidation of combustible materials. U. S. patent 2,824,058. Filed Dec. 14, 1953. 7 claims. Assigned to Sterling Drug Inc. [Cl. 210-63.] In a wet combustion process for spent pulping liquor, the extent of oxidation obtained is determined by varying the concentration of combustibles in the reaction zone.

### Feb. 25, 1958

Boiney, Joseph F. Dicyandiamide phenlaldehyde resin varnish and process of preparation. U. S. patent 2,824,849. Filed April 26, 1956. 4 claims. Assigned to Westinghouse Electric Corp. [Cl. 260-233.4.] The resin is useful in preparing paper laminates.

Drechsel, Erhart K. Reaction products of an alkyleneimine and an organic carbonate. U. S. patent 2,824,857. Filed June 28, 1954. 16 claims. Assigned to American Cyanamid Co. [Cl. 260-77.5.] The products are of use in laminating paper, impregnating pulp preforms, and in adding to pulp for papermaking.

Wittcoff, Harold. Polyamide resin suspensoids. U. S. patent 2,824,848. Filed Aug. 8, 1956. 8 claims. Assigned to General Mills, Inc. [Cl. 260-29.2.] A heat-sealable composition of use in application to paper is described.

### March 4, 1958

Harvey, Mortimer T., and Rosamilia, Peter L. Compositions comprising amine modified acetone formaldehyde resin and method of making same. U. S. patent 2,825,713. Filed Oct. 20, 1951. 4 claims. Assigned to Harvel Research Corp. [Cl. 260-.45.2.] The resin is useful in preparing gaskets and the like from paper.

### March 18, 1958

Freyhold, Helmut von. Waterproof coatings and adhesives. U. S. patent 2,827,384. Filed June 21, 1955. 7 claims. Assigned to Philadelphia Quartz Co. [Cl. 106-74.] Aluminum tartrate or citrate or the like is employed as a waterproofing agent for sodium silicate adhesives and coatings for paper and board.

### March, 25, 1958

Gifford, Earl C. Chinoline yellows. U. S. patent 2,828,311. Filed Aug. 10, 1956. 4 claims. Assigned to American Cyanamid Co. [Cl. 260-289.] The dyes are of use as pulp additives in coloring paper.

Thompson, William E. Aqueous drilling fluid. U. S. patent 2,828,258. Filed Nov. 28, 1955. 12 claims. Assigned to Sun Oil Co. [Cl. 252-8.5.] Tannin extracts and lignosulphonates are employed.

### April 22, 1958

Aycock, Benjamin F., and Hankins, Elinor M. Acrylamide derivatives, their polymers and methods of producing them. U. S. patent 2,831,833. Filed July 18, 1955. 17 claims. Assigned to Rohm & Haas Co. [Cl. 260-77.5.] The product is of use as a pulp additive for wet-strenghtening paper.

Kamlet, Jones. Preservation and improvement of assimilability of feeding stuffs. U. S. patent 2,831,769. Filed Aug. 11, 1955. 11 claims. Assigned to Crown Zellerbach Corp. [Cl. 99-2.] Waste newsprint and other low-grade animal feeding stuffs are upgraded by adding minor amounts of levulinic acid.

### May 6, 1958

Iler, Ralph K. Composition comprising water soluble organic polymer and colloidal silica and process of coating therewith. U. S. patent 2,833,661. Filed Nov. 28, 1952. 5 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 106-193.] This is a paper-coating composition for improving wet-rub resistance and ink-absorption properties.

### May 13, 1958

Suen, Tzeng J., Jen, Yun, and Moore, Sewell T. Process for preparing amine-aldehyde resinous compositions and product obtained. U. S. patent 2,834,756 Filed June 10, 1954. 8 claims. Assigned to American Cyanamid Co. [Cl. 260-72.] These are wet-strength agents for paper.

### May 20, 1958

Bartlett, Francis J. W. Method of preparing vinyl resin granules and covering containing same. U. S. patent 2,835,620. Filed April 4, 1955. 4 claims. Assigned to Francis J. W. Bartlett and William W. Prager. [Cl. 154-49.] The granules prepared are for calendering onto paper or other backings.

### May 27, 1958

Piccard, John A., and Signaigo, Frank K. Fibrous pellicle comprising oriented ethylene terephthalate polymer and amorphous ethylene terephthalate binder and process for making same. U. S. patent 2,836,576. Filed Dec. 31, 1954. 4 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-45.4.] This is a synthetic fiber paper.

### June 3, 1958

Melamed, Sidney. Monomeric polymerizable ureido and thioureido vinyl ethers and methods for producing them. U. S. patent 2,837,499. Filed April 15, 1955. 9 claims. Assigned to Rohm & Haas Co. [Cl. 260-77.5.] The ethers may be used as paper wet-strength agents.

### June 17, 1958

Albisetti, Charles J. An alkoxy aluminum chelate, a dispersion of it in an organic liquid and a water repellant porous object. U. S. patent 2,839,421. Filed April 6, 1955. 8 claims. Assigned to E. I. du Pont de Nemours & Co. [Cl. 106-287.] The chelates are used to impart water repellency to paper.

Sanders, Judson H. End wrap impregnated with a fatty acid ester of a polyhydric alcohol. U. S. patent 2,839,066. Filed Feb. 11, 1955. 4 claims. Assigned to Procter & Gamble Co. [Cl. 132-46.] A hair-waving end wrap is made of impregnated paper.

### June 24, 1958

Lytton, Marion R. Method of producing all skin rayon. U. S. patent 2,840,449. Filed June 29, 1955. 2 claims. Assigned to American Viscose Corp. [Cl. 18-54.] $\beta$-Hydroxyethyl hydrazine is employed as a viscose additive.

Thumm, Byron A. Method of producing all skin rayon. U. S. patent 2,840,448. Filed June 29, 1955. 7 claims. Assigned to American Viscose Corp. [Cl. 18-54.] The spinning bath additive is monoaminopyridine.

Wirt, James R., and Kelly, Harold C. Method for coating foodstuffs and article thereby obtained. U. S. patent 2,840,476. Filed Aug. 29, 1957. 16 claims. Assigned to Dow Chemical Co. [Cl. 99-166.] Ethylcellulose is used.

Wirt, James R., Kelly, Harold C., and Krajewski, Richard M.

Pellucid composition and method for coating foodstuffs and articles thereby obtained. U. S. patent 2,840,474. Filed Jan. 23, 1956. 10 claims. Assigned to Dow Chemical Co. [Cl. 99-166.] Ethylcellulose is used.

**July 8, 1958**

Morris, Kenneth G., Roediger, Joseph C., Newburg, Raymond G., and Sayko, Andrew F. Process for preparing improved asphalt. U. S. patent 2,842,507. Filed March 7, 1955. 5 claims. Assigned to Esso Research and Engineering Co. [Cl. 260-28.5.] The product is of use in laminating paper.

**July 15, 1958**

Melamed, Sidney. New quaternary ammonium compounds in which the nitrogen atom carries an alkoxymethyl group. U. S. patent 2,843,573. Filed March 21, 1955. 13 claims. Assigned to Rohm & Haas Co. [Cl. 260-86.1.] These compounds are for treating paper, among other uses.

**July 29, 1958**

Woodruff, Howard C. Water-soluble polyesters curable to insoluble polymers. U. S. patent 2,845,402. Filed Dec. 28, 1953. 11 claims. Assigned to General Electric Co. [Cl. 260-75.] Water-soluble polyesters curable to water-insolubility and of use in printing or treating paper are provided.

**Aug. 12, 1958**

Melamed, Sidney. Aliphatic poly(oxymethylisothiocyanates) and methods for making them. U. S. patent 2,847,441. Filed April 15, 1955. 9 claims. Assigned to Rohm & Haas Co. [Cl. 260-454.] The products described may be used in preparing paper-laminating agents.

**Sept. 30, 1958**

Clark, Charles K., and Nason, Robert O. Stabilized tall oil soap and floating soap products. U. S. patent 2,854,442. Filed Feb. 6, 1958. 14 claims. Assigned to Crossett Chemical Co. [Cl. 260-97.5.] Thiosulphates are added to prevent spontaneous heating.

Knapp, Samuel B., and Wethern, James D. Rapid kraft pulping process for bagasse and other fibrous, nonwoody lignocellulosic plant materials. U. S. patent 2,854,334. Filed Nov. 8, 1954. 13 claims. Assigned to Hawaiian Development Co., Ltd. [Cl. 92-9.]

Monson, Louis T., and Dickson, Woodrow J. Oxyalkylated lignin sulfonic acid compounds and method of preparing same. U. S. patent 2,854,444. Filed June 4, 1953. 7 claims. Assigned to Petrolite Corp. [Cl. 260-124.]

# LETTER TO THE EDITOR

To the Editor, *Tappi:*

## *Weight Volume Measurements of Pulpwood Revision of Official Standard T 7p-53*

Concerning the proposed standards printed on Page 133 A of the February, 1959 edition of *Tappi* 42, No. 2, I feel some comments should be made about these methods.

In general, the methods described work well for such things as softwood, or veneer cores, or extremely well prepared hardwood. There are, however, serious errors introduced in the analysis of hardwood which is not too well prepared in the calculation of the solid volume content by the diameters of the butts and also in the determination of solid content by the photographic dot grid method when attempting to get precise measurements on individual loads. We have been considering the possibility of publishing some of the work that we have done in dealing with these relationships because very serious biases arise in the employment of these methods in the evaluation of the solid content of rough hardwood. It is almost because of these problems that more and more mills are beginning to buy their wood by weight, particularly those who are buying hardwoods.


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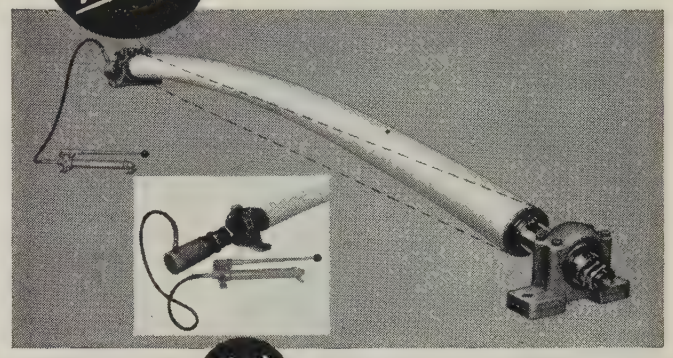

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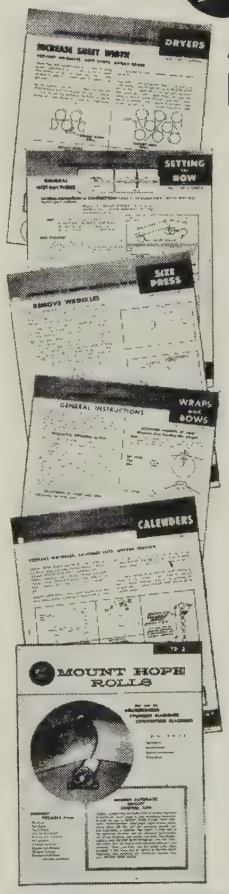


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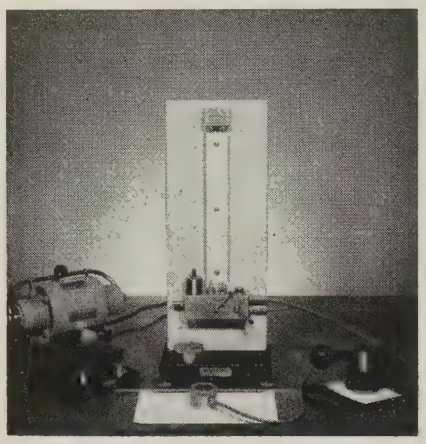

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The problems are caused primarily by the fact that the hardwood sticks are never as straight as softwood and the branches are larger so that the actual butt ends of the branches on the bolts are larger and more difficult to prepare. Also, the occurrence of forked trunks of the trees leads to many of the bolts being in the shape of a Y with one of the sides cut short and an irregularly shaped log being produced. It seems a shame to penalize a farmer for not improving the preparation of his wood when handling a log of this kind, particularly when the wood is still perfectly good for pulping use.

We have found in the application of the cross-diameter measurement method for the determination of solid content that in the evaluation of hardwoods, discretion must be used and what we term the "equivalent diameter" measurements of the butt must be used instead of the actual measurements if the butt is oval because it has been cut at the base of Y. The equivalent diameter values correspond to the approximate diameter of the full length of the stock and that, in effect, deliberately omits the contribution to the solid content caused by the odd shaped area of the log. Undoubtedly, this tends to give a bias in the direction of measuring the solid content as being slightly lower than it actually is when compared to a completely direct method such as complete immersion of the logs, however, scalers can be trained to do a consistant job of using this method and getting good reproducibility of results.

The same physical characteristics of the hardwood logs lead to quite serious biases in the application of the photographic dot grid technique with the result that the correlation between the two methods is very good for well prepared wood with a very high solid content (such as veneer cores or high quality peeled spruce) but very poor correlation with poor quality wood. It has been possible to derive from statistical sampling theory estimates of the accuracy of determinations made by the dot grid method and to prove these experimentally. The important feature that shows up directly is the fact that the accuracy of the method is very good for high solid content cords, i.e., a large proportion of filled area in the photograph, but the accuracy decreases as the per cent of solid area in the photograph approaches 50% or about 64 solid cu. ft. per cord. It is unfortunate that at the point where a quick method like the photographic dot grid technique would be most useful with poor quality wood it is here that the method has inherently the largest error and at the same time the worse bias. A considerable amount of work that we have done, for instance, has indicated that on rough hardwood comprising primarily maple and elm that the photographic solid content will average about 82 solid cu. ft. per cord but the same determination done by the calculation of the volumes of the logs gives a value of only 73 solid cu. ft. per cord. When the same test is applied to birch veneer cores at approximately 104 solid cu. ft. per cord the difference in the two values is within the experimental error and the fundamental statistical error of the photographic technique of about two solid cubic feet at that level.

In general, the revised methods proposed are quite adequate for very well prepared wood but unfortunately they fall rather short of meeting the requirements of the evaluation of rough hardwoods of low solid content. It is undoubtedly this same experience with other companies that has prompted so many mills in the last few years to go to the purchase of rough hardwoods by weight rather than by cord and do away with this kind of evaluation altogether.

H. M. Banfill
*Technical Control Superintendent*
*Howard Smith Paper Mills, Ltd.*
*Cornwall, Ont.*

# RECENT BOOKS

**Economics of American Forestry.** By Albert C. Worrell, Associate Professor of Forest Economics, Yale University. John Wiley & Sons, Inc., New York, 1959. Cloth, 6 × 9, 441 pages. $9.75.

The author states that the value of economics education to foresters lies in the viewpoints and perspectives which are developed rather than in facts and figures learned. It is important that forestry be reviewed as an economic activity in which choices and decisions can be made on logical grounds.

The coverage of the field is rather complete. Not since 1943 has such complete coverage been attempted. The book covers basic economic relationships, private enterprise, consumer demand, processing, growing, harvesting, capital, labor, marketing, social and private costs, future demand, government, and policies relating to forest economics.

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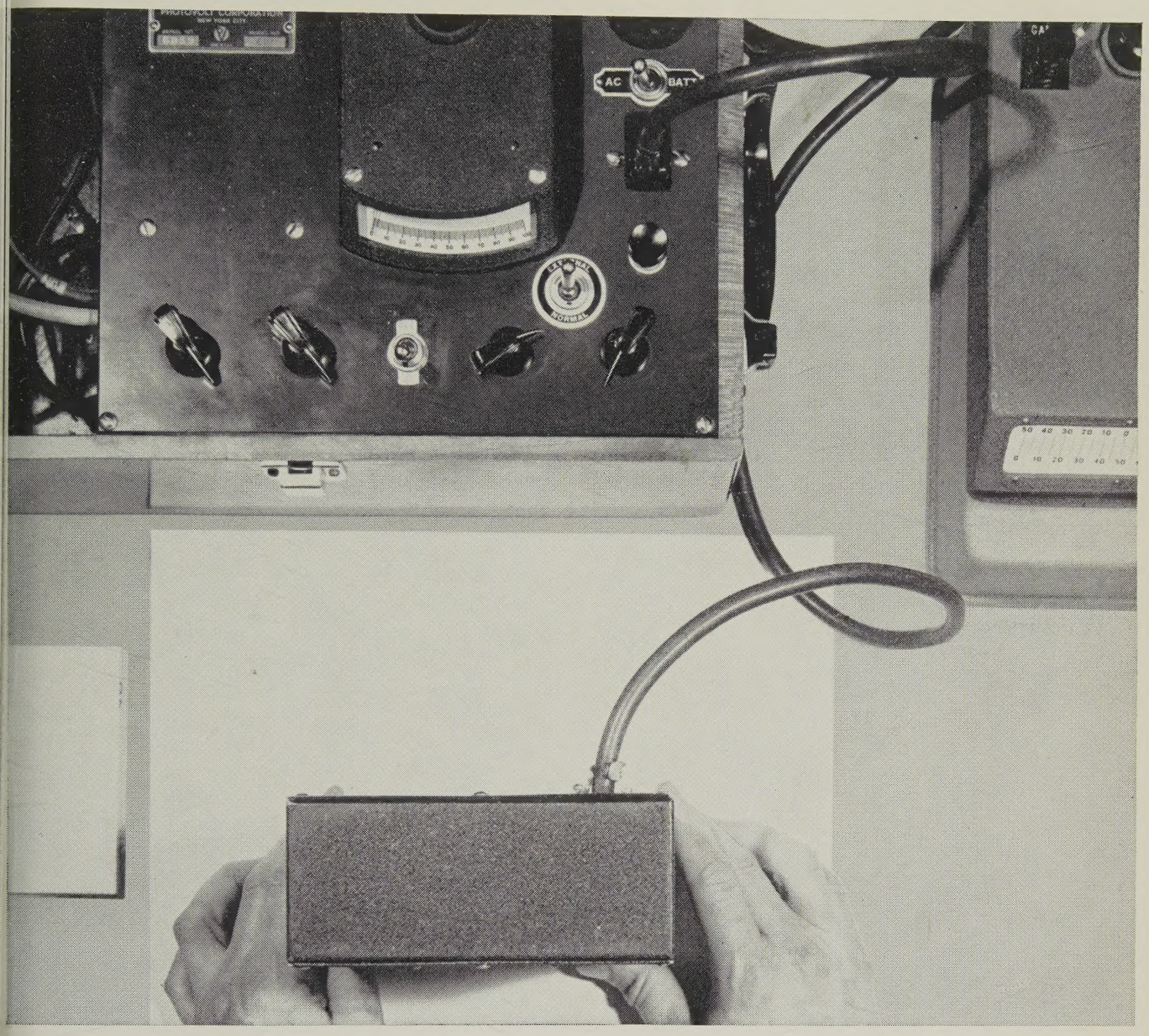



# PAPERBOARD COATING GLOSS JUMPS

## 65% . . . Dow Latex 512-L solves coatings problem

*Problem:* How to step up coating gloss and gloss ink holdout on paperboard for packaging? A company that recently asked this question got a quick answer—Dow Latex 512-L. They replaced 50% of the binder in their regular coating with Dow Latex 512-L, applied it with regular machine coaters. The result? Greatly improved gloss ink holdout, and an eye-catching 65% increase in coating gloss. Here are the details:

| | Photovolt 60 Gloss | | Application Solids |
|---|---|---|---|
| | M. D. | C. D. | |
| Coating containing 50% latex | 26 | 23 | 51% |
| Former coating | 16 | 13 | 47% |

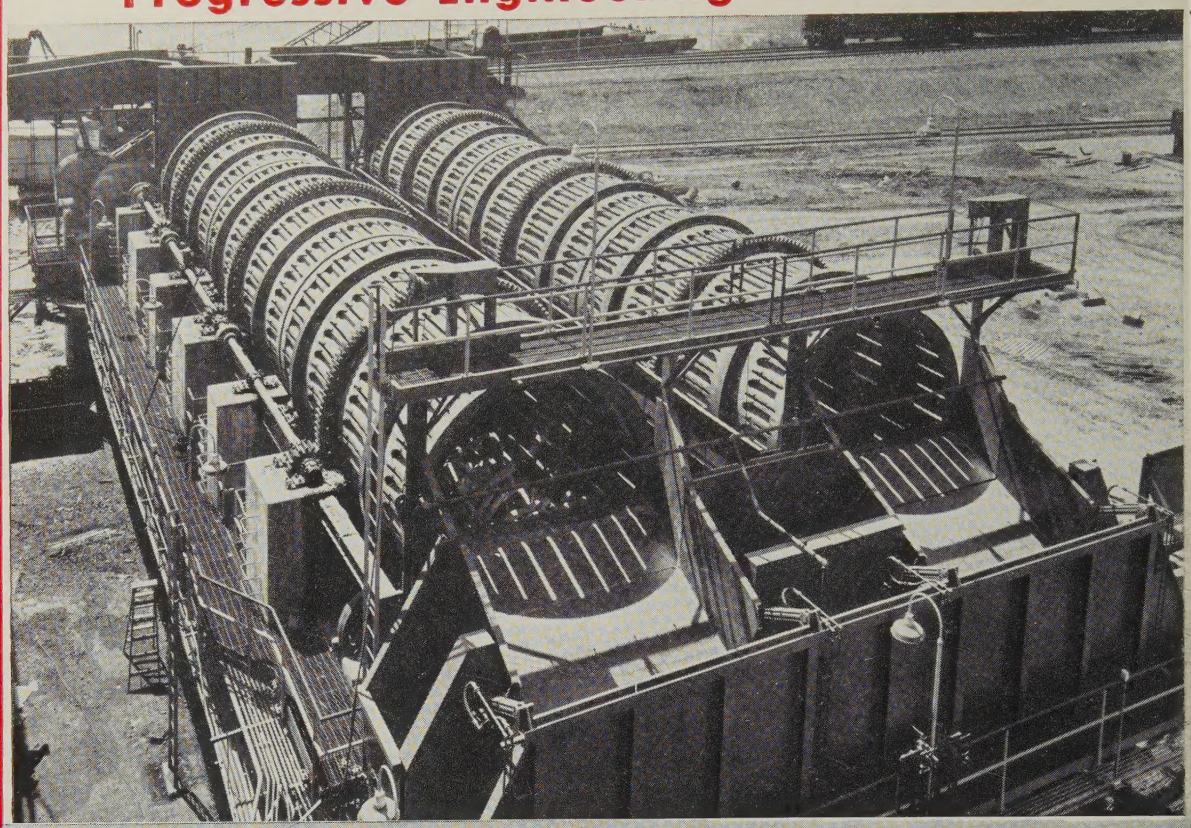
Both the machine direction and the cross direction gloss increased by 10 points. And the use of latex improved gloss ink holdout, allowed higher coating weights, reduced drying time, improved flexibility and increased production! And Dow Latex 512-L is economical!

Dow Latex 512-L can give your paperboard and paper these sales advantages. Many leading paper and paperboard manufacturers have already discovered the benefits of Dow Latex 512-L. For technical information contact the nearest Dow sales office or THE DOW CHEMICAL COMPANY, Dept. 2320FC5, Midland, Michigan.

**THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN**

# The "Weldrum" Barker...

## Progressive Engineering in action



*These 67½ feet three-section "Weldrum" Barkers are installed at Bowaters Southern Paper Corporation, Calhoun, Tennessee.*

**Reducing the customer's cost of drum barking wood . . .**

. . . is the primary purpose behind the design of every "Weldrum" Barker.

This continuing research may be called progressive engineering and it is done in full co-operation with the engineering staffs of our major pulp and paper producers.

Actually, our program of modifying and improving the "Weldrum" Barker has produced unparalleled savings in drum barking costs.

**Four basic models cover practically all drum barking operations:**

- *12′ by 45′ two-section drum for most soft woods*
- *12′ by 45′ two-section drum with solid plate inlet section for extra washing or frozen wood*
- *12′ by 67½′ three-section drum for highly resinous wood*
- *12′ by 67½′ three-section drum for hard woods*

For specific information and detailed estimates, contact your nearest Ingersoll-Rand office or write direct to Canadian Ingersoll-Rand Co. Limited, 620 Cathcart Street, Montreal, Canada.

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